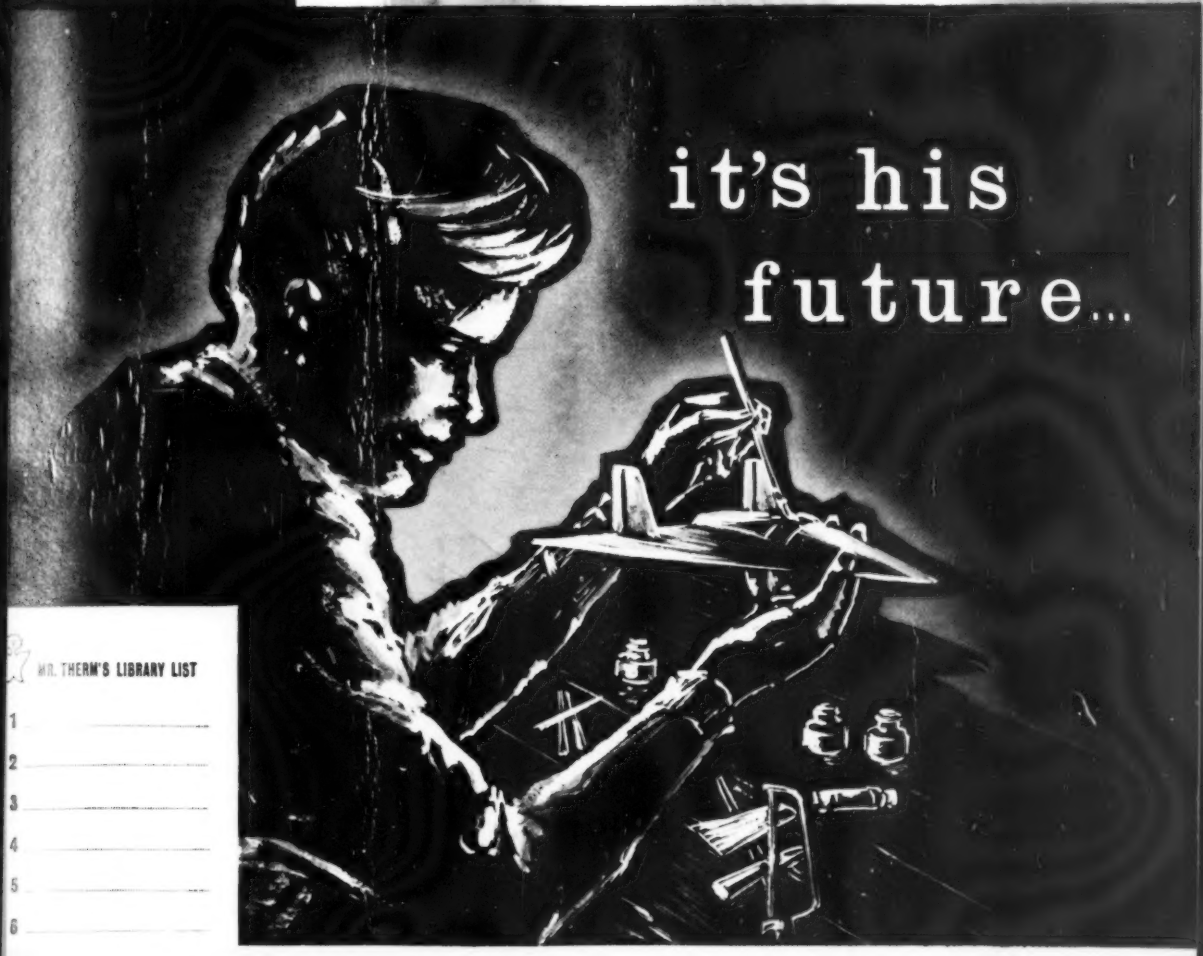
metal finishing

PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, METAL SPRAYING and all METAL FINISHING PROCESSES

Vol 6 No. 67 (New series) JULY, 1960



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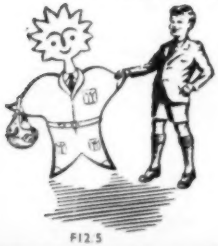

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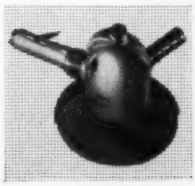
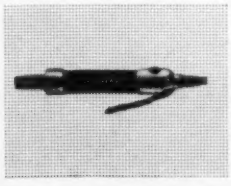
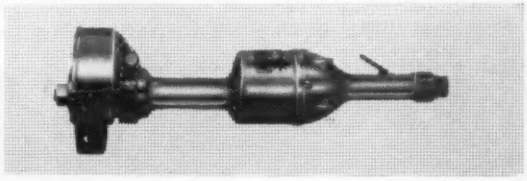


LSF 12



LSR 61



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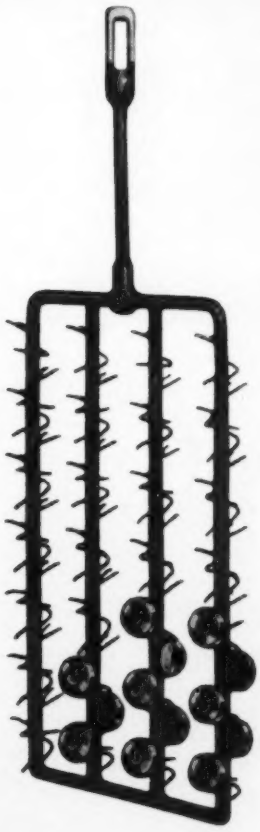

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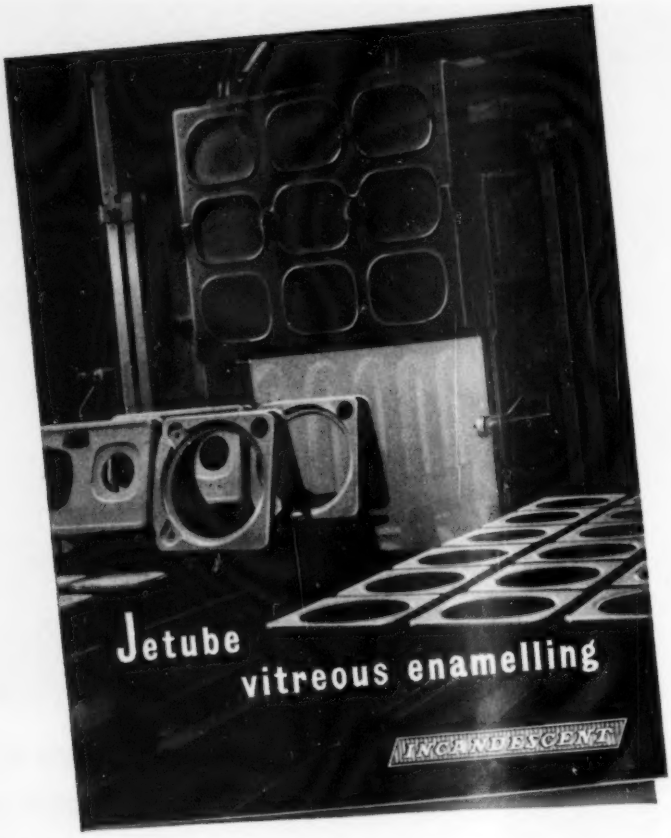

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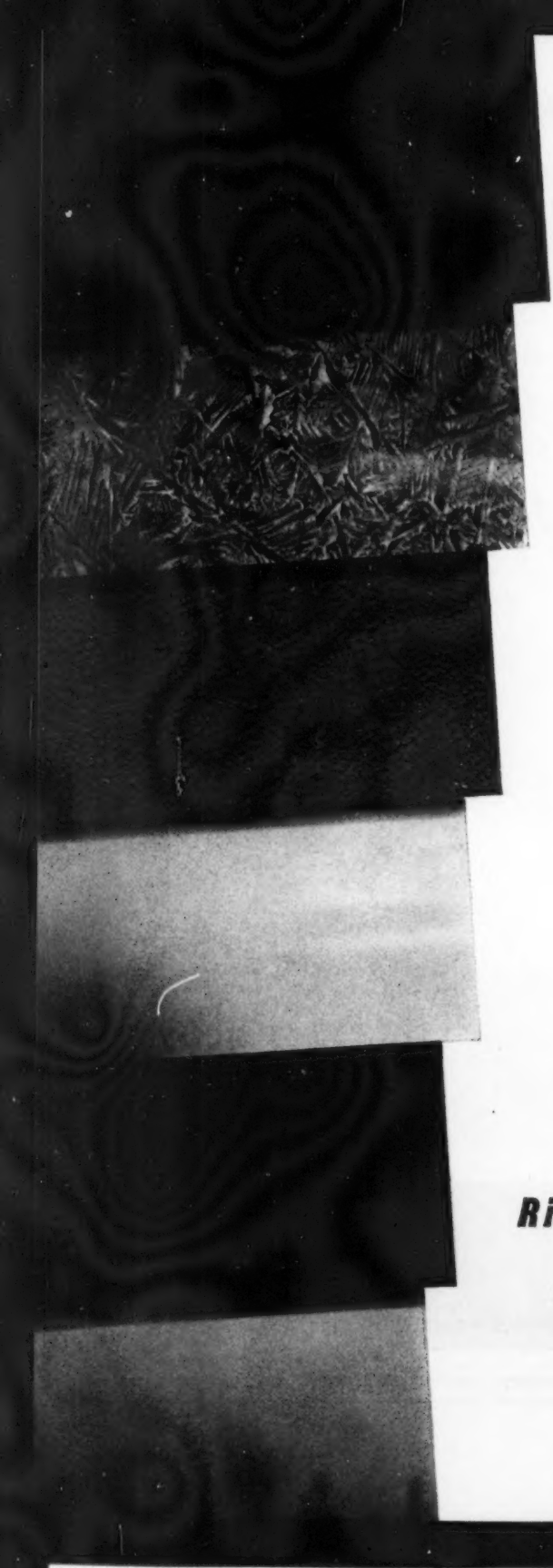

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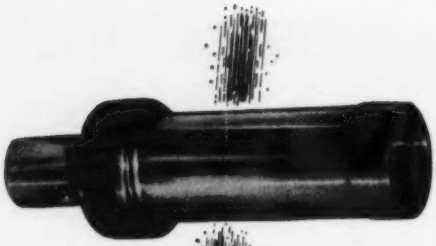

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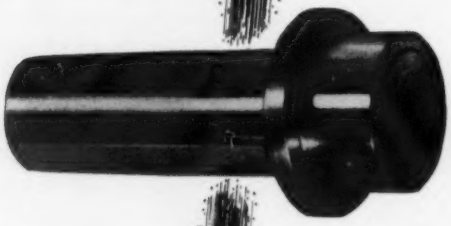

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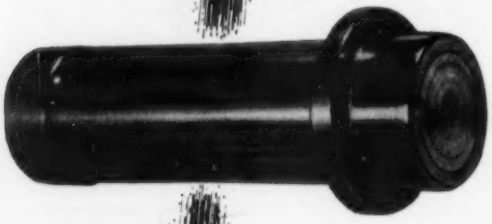

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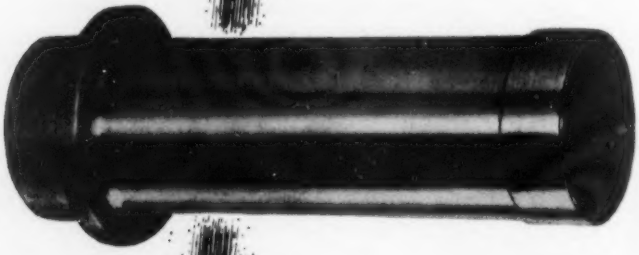

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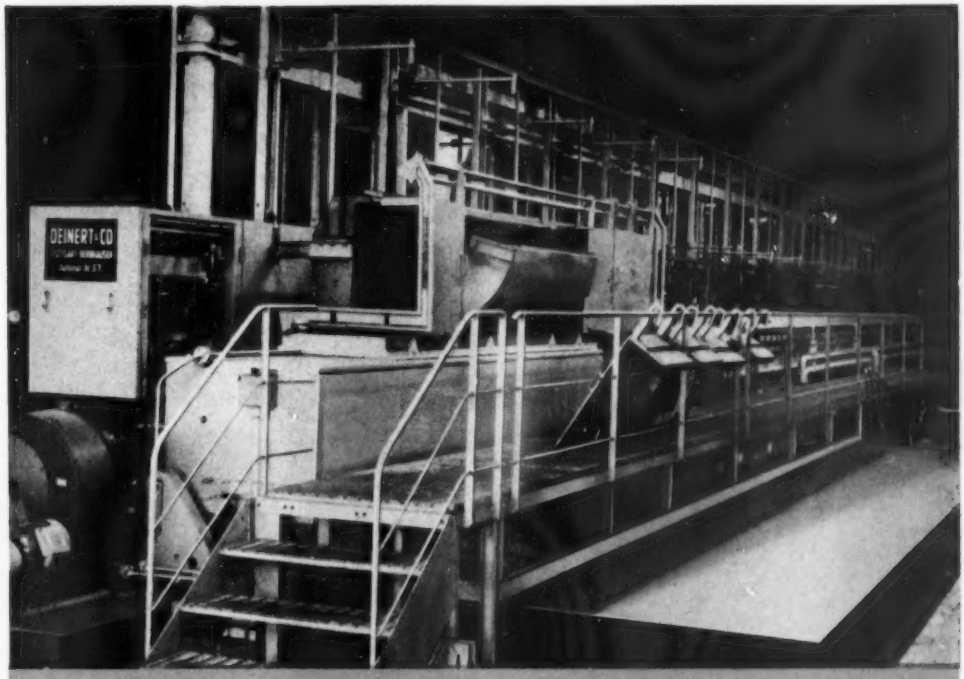

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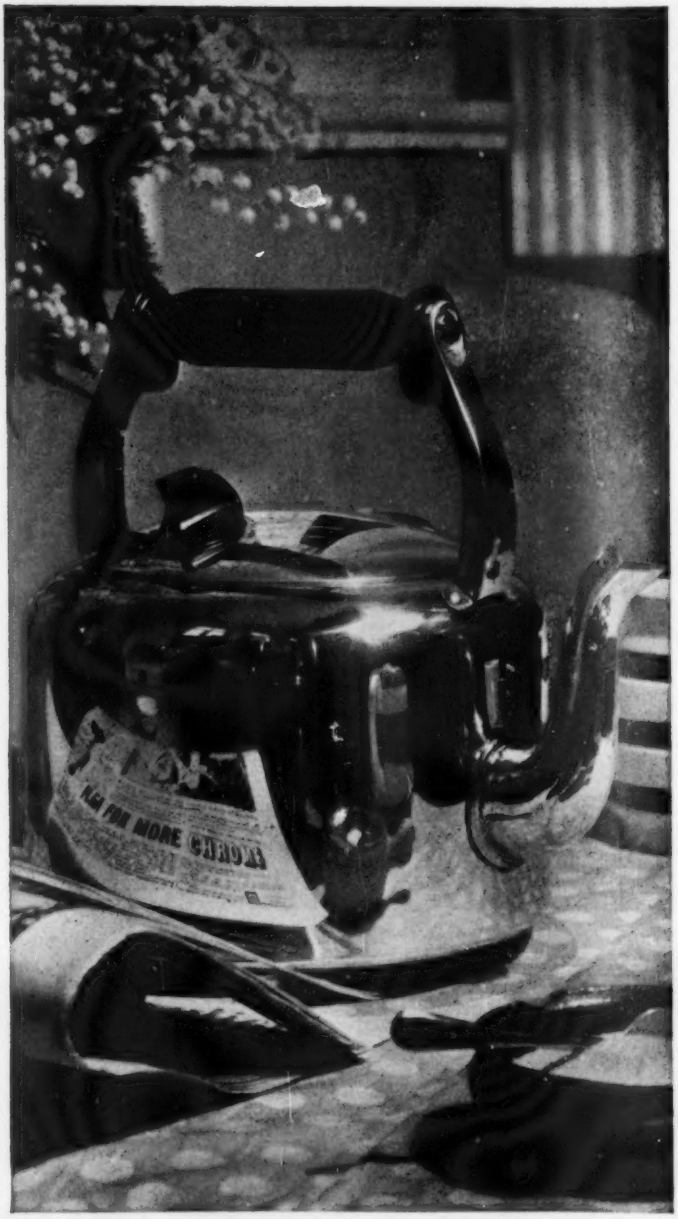

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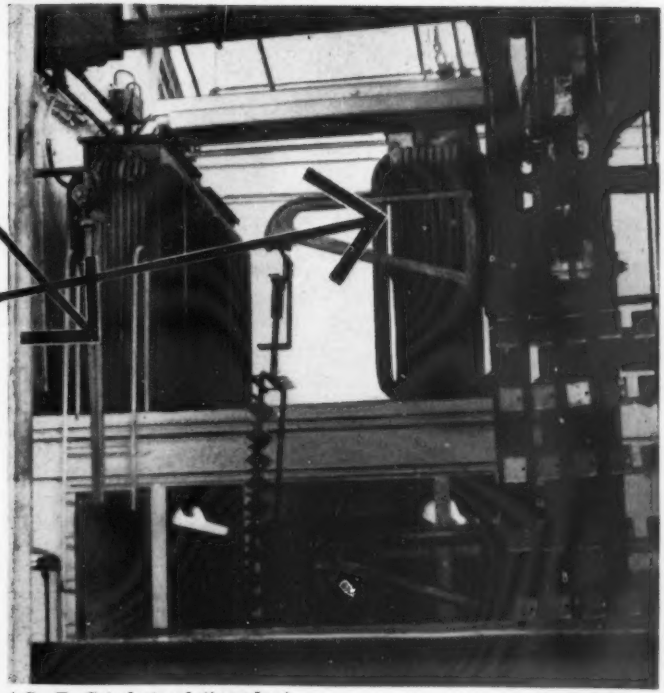

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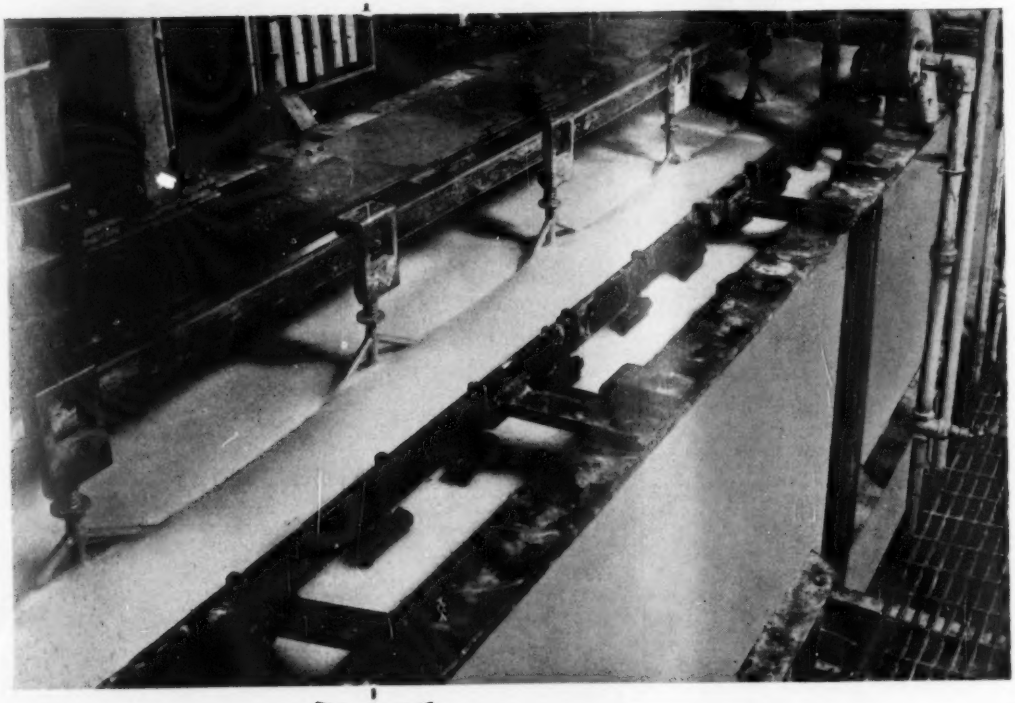

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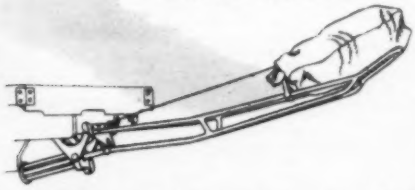

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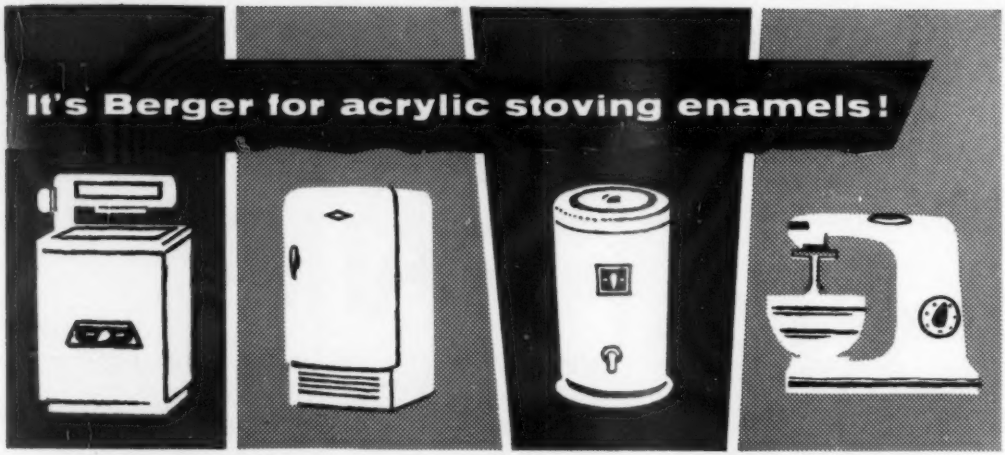

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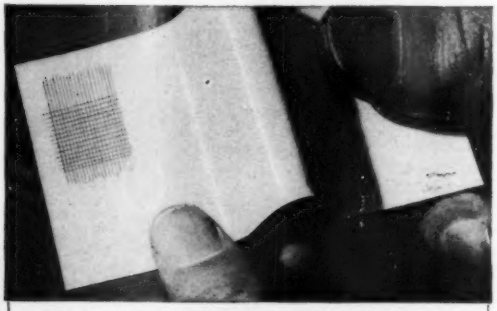

Bergercron applied direct to pretreated metal. Photograph of test panel showing bend test and 1 mm. cross hatch at hardness 5H.

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ABOVE *Without 'Trisec' Metal Drying Assistant, drops of water on a sheet of metal (top) leave stains on evaporation (bottom).*

BELOW *With 'Trisec' Metal Drying Assistant, the water film is displaced (top) leaving no stains (bottom).*

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metal drying assistant

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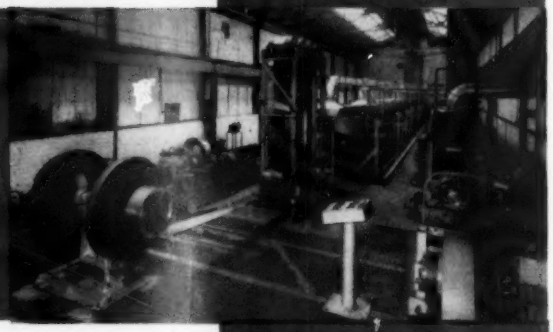
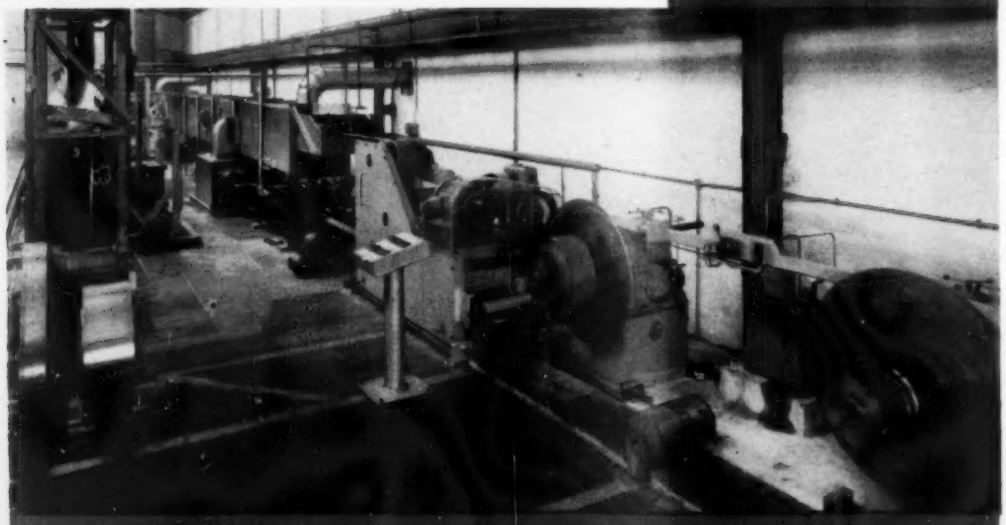


Photographs reproduced by courtesy of Messrs. Coated Strip Limited, Walsall.



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metal finishing Journal

July, 1960 Vol. 67, No. 6 (New Series)

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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

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Heating coils in ICI Titanium are being adopted at a rapidly increasing rate to replace jacket heating—or coils in more conventional materials—for chrome and nickel plating vats. The advantages of using titanium coils speak for themselves—

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NARROWING HORIZONS

A CERTAIN over-pertinacious lady when introduced socially to an eminent eye specialist, sought to benefit from some free medical advice by drawing his attention to an affliction in her right eye, only to be blandly rebuffed by his observing that having reached the higher realms of specialization, he confined his attentions solely to left eyes. While this legend is undoubtedly apocryphal it can be regarded as a not unjustifiable satire on one of the more marked tendencies of the present day, the trend towards specialization in ever-narrowing fields.

If one can apply the terminology of military strategy by describing the expansion of human knowledge as an assault on the frontiers of ignorance, it can be successfully argued that the greatest degree of penetration is achieved by concentrating the attack on a narrow sector rather than on a broad front. The whole field is so vast that it is given to few to have even a passing familiarity with more than a small fraction of it, but while the frontier of knowledge may be ever advancing, it is at the same time lengthened, with the attendant danger of bringing about a breakdown in communications, not only between individual sectors at the front but also between the more advanced positions and the base.

There is no lack of signs that this danger is a real one and that problems of communication are already acute in some areas of activity, and are playing a significant part in impeding operations. This state of affairs is arising not from an insufficiency or inadequacy in communications channels but from the sheer complexity of the system as it is evolving. It is by no means rare to hear comments to the effect that it is impossible to read everything that is published in relation to a given branch of science or technology, or that it is sometimes quicker to carry out a piece of research with the risk of duplicating previous work than to search the literature to discover if it has in fact been done before.

Library and abstracting services and the publication of abstracts have multiplied apace and the whole task of literature scanning and indexing has reached such gigantic proportions that electronic computers are now being pressed into the service.

The situation has reached the stage where it may be appropriate to question whether this proliferation of channels of communication has not become so complex that it is tending to defeat the purpose for which it was created. Scarcely a month passes without the announcement of the appearance of a new periodical publication catering for an ever more exclusive and specialized section of science, technology or industry ; new technical societies and institutes emerge, and splinter groups hive themselves off from older bodies ; exhibitions, conferences and committees, all stake their claims for a share of the very restricted amount of time that can be spared away from the laboratory, workshop or office.

Information which is available but unseen, published but unread, might just as well not exist at all for all the contribution that it can make to progress. There is moreover the proverbial pitfall ever present that one may fail to see the wood, not so much for the trees, but because of a too single-minded attention to an individual tree or to a particular acorn growing among its branches.

Metal finishing (or bricklaying or brewing) is not a technological end in itself, but is one facet of a large technical and industrial complex. Attempts to consider it in isolation from this context may well prove misleading.

Talking Points

by "PLATELAYER"

TOPICAL COMMENT FROM THE MAIN LINES AND SIDE LINES OF METAL FINISHING

THE RACK PROBLEM

IN spite of all the improvements which have taken place in the design and insulation of plating racks, they still present a formidable cost and maintenance item. This makes one wonder whether a radical re-approach to the entire problem of racking might not be desirable. For example, it might be possible to consider doing away with racks altogether in some cases by a process of re-tooling. Many pressings are blanked from sheet and strip metal, so that it is possible to leave interconnecting strips between them which could be removed after polishing and plating. An entire group of pressings would thus constitute its own plating rack. Die-castings lend themselves particularly well to this kind of method of manufacture if they are relatively small.

Of course, there are many objections to applying such techniques generally, but it should not be impossible to start in a small way with selected components. Each application would have to be studied from the design stage right through to the final assembly operation. The difficulties are great, but the rewards could be a major advance in automation as applied to plating, by the elimination of the large amount of labour required for the racking and un-racking operations.

NO PARKING — NO FINISHING

THE success of the metal-finishing industry in all its aspects is quite considerably bound up with the motor trade, which provides it with a substantial part of its business. Hence, the expansion of motor-car manufacture is bound to lead to fresh demands for finishing plant and processes. The extent of this upsurge can be gauged from the fact that the British Motor Corporation alone is now turning out over half a million motor cars a year — almost as much as the entire industry produced in 1954. This output is equalled by that of Ford, and the total output of the industry is likely to be over 1,300,000 cars per annum, over the next two or three years.

There is, however, a factor that may seriously affect sales and that is the increasingly fierce prohibitions on car parking in cities where most cars are used. Good roads even are not enough, because unless cars can be parked for short peridos fairly readily in a town, they are not worth owning. The present attitude of the authorities is that traffic must be kept moving at all costs ; anybody who wants to stop is a selfish, obstructive wretch who must be dealt with ruthlessly. There is a curious reluctance on the part of officialdom to see that the sole object of taking a motor car onto the road is to stop it somewhere.

GOLDEN AGE

IN the United States, at any rate, this seems to be the golden age for building. In Pittsburgh, a huge new hotel clad entirely in gold-anodized aluminium is under construction. This will be the fifth aluminium-clad building to go up in that city, although the others have been more subdued in tone. The gold fever has spread to stainless steels also, and alloys chemically treated to produce a permanent gold finish are now available and are being used on an increasing scale. Both of these finishes are facing competition from plain steel panels, stove or vitreous enamelled in a considerable variety of colours, including gold.

The success of this kind of colourful construction depends on relative freedom from air pollution ; otherwise the result could prove unsightly in a short space of time.

WEIGHTY MATTERS

FOR a fixed fee, the Patents Offices of most countries will issue a patent. They will also publish and print documents for the same fixed charge which generally covers the costs incurred. It is therefore with some alarm that we note the issue of an American Patent Specification for automatic telephone equipment, 266 pages long with 354 sheets of drawings. The documents weigh no less than 11 lb.

It is sincerely to be hoped that such a tendency does not develop in this country. It would be rather difficult, we imgaine, to have a scale of patent charges based on the weight of the documents concerned. The alternatives are either to raise the charges for patents as a whole or to involve the taxpayer in a loss.

SPOONERISM

IT would not be surprising to find that in all probability the largest single retailer of cutlery in the country is a firm of breakfast cereal manufacturers. This kind of competition can be none too welcome to the trade.

One form of retaliation might be for someone to offer to supply, say, a dozen packets of another breakfast cereal in exchange for five shillings and the lid taken from a box of half a dozen E.P.N.S. dessert spoons.

ZINC PLATING OF STEEL SHELL CASES

Some Details of Practice for Plating Internally and Externally

by H. J. BACHE* and R. F. C. ROBINSON*

ELECTRODEPOSITED zinc is a natural choice when steel has to be protected from atmospheric corrosion. There are several reasons to account for this :—

(a) In the cell Zn/Fe, zinc is anodic to iron (or steel) and therefore protects the basis metal sacrificially. The practical result of this is that in the neighbourhood of a pore in the coating or a *small* discontinuity caused, say, by mechanical damage, the zinc itself will dissolve whereas the steel, being cathodic, will not. Consequently, provided the pore is not too large, the basis steel will be protected from rusting by this sacrificial effect of the zinc.

(b) A deposit of zinc can have greater corrosion resistance conferred on it by treatment in a suitable solution containing essentially chromic acid and sulphuric acid. In this way a coloured chromate film is produced which provides extremely good corrosion resistance.

(c) Zinc is a cheaper metal to employ than the other well-known element cadmium which is often used (because of its sacrificial behaviour) to protect steel against corrosion. Theoretically zinc should protect steel rather better than cadmium because the relative P.D. between zinc and steel is greater than that between cadmium and steel.

Accordingly, when the problem of protecting steel shell cases against corrosion was under consideration, it was quite logically decided that zinc suitably passivated should be used for this purpose.

It was necessary for the cases to be plated both externally and internally with zinc and the thickness specification called for 0.0004 in. on the outside of the case and 0.0002 in. on the interior.

The output required was such that it could most economically be handled by treating the work in a fully automatic plant.

The plant selected in this instance was of the Efco-Udylite return type, hydraulically operated in which the process tanks are arranged in two parallel rows on a steel grillage which supports a row of vertical columns arranged along the centre line between the tanks.

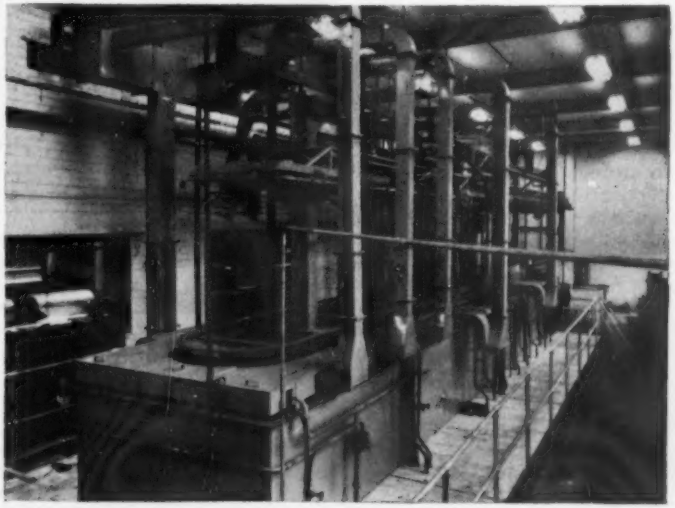


Fig. 1.—General view of zinc-plating plant.

* Electrochemical Engineering Co. Ltd.

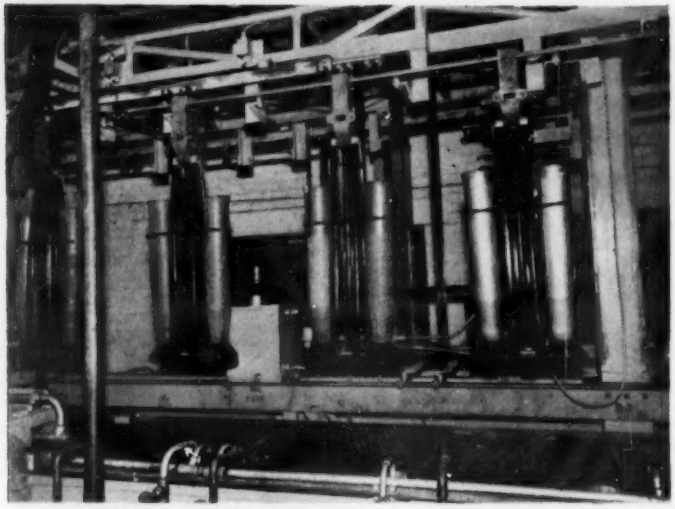


Fig. 2.—(left) Side view of part of plating plant showing shell cases on racks.

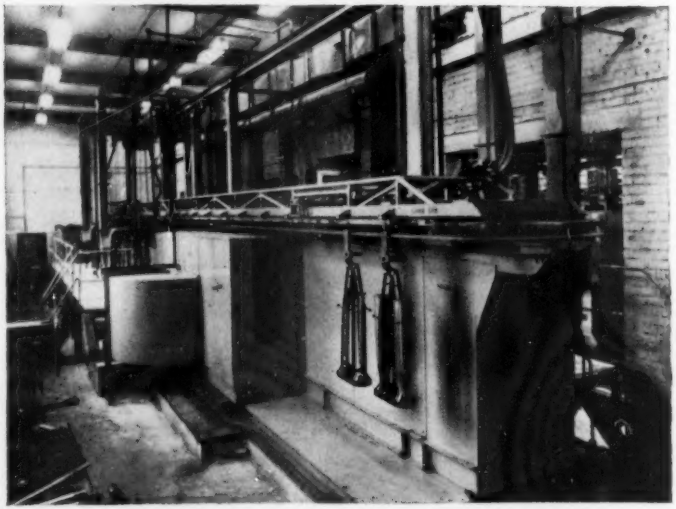


Fig. 3.—(below) View of loading end of plating plant.

The ' work rail ' along which the shell-case holding racks slide, is divided into various lengths and where the racks have to be transferred from one tank to the next, this work rail is attached to a lifting frame supported by roller chains connected to the hydraulic cylinder which raises and lowers the lifting frame. The work rail over multi-stage tanks is supported on brackets cantilevered out from the central structure, suitably insulated, and where necessary connected to rectifiers which supply the plating current.

Horizontal movement is imparted to the racks by Tee-section bars running full length of the machine on either side, which carry pivotted pawls engaging with the racks on the forward movement but free to pivot over the racks on the return stroke.

The Tee bars are interconnected at the ends of the plant by quadrant plates and are motivated by hydraulic cylinders.

The sequence of mechanical movements is controlled by an electrically driven multi-cam and switch device in conjunction with a time clock, solenoid hydraulic control valves and limit switches.

The process sequence for the automatic plant comprised the following steps :—

(1) Anodic alkaline treatment in Culene, 300°F. 1 minute 49 seconds. Current density 50 amp. per sq. ft. on both the inside and the outside of the cases. Air agitation.
(2) Cold rinse.
(3) Cold rinse.
(4) Mouth pickle. Sulphuric acid solution, 10 per cent by volume. 160°F., 4 minutes 13 seconds. Air agitated.
(5) Body pickle in sulphuric acid solution, 10 per cent by volume. Temperature 150°F. Time 3 minutes. Air agitated.
(6) Cold rinse.
(7) Cold rinse.

(8) Anodic alkaline treatment as for Step (1), 1 minute 49 seconds.
(9) Cold rinse.
(10) Acid dip in sulphuric acid solution, 10 per cent by volume. Room temperature. Time 37 seconds. Air agitated.
(11) Cold rinse.
(12) Cold rinse.
(13) Zinc plate, 85°F. 11 minutes 25 seconds. Air agitated. External current density 40 amp. per sq. ft. Internal current density 20 amp. per sq. ft.
(14) Cold rinse.
(15) Cold rinse.
(16) Passivate. 37 seconds. Using modified Specification No. D.T.D. 923 solution. Air agitated.
(17) Cold rinse.
(18) Cold rinse, followed by a drying operation.

There are a number of points of interest in connexion with this sequence and these will now be dealt with.

It will have been noticed that the alkaline cleaners were air agitated. Accordingly, it was necessary to use a type of cleaner which did not contain a wetting agent.

The term " mouth pickle " probably requires some explanation. During the manufacture of a shell case, the open end or mouth receives a different type of heat treatment from that given to the body. This results in the formation of a dark film of oxide in the area of the mouth. Since the body of the case requires nothing more than a light pickling operation, only the mouth is immersed in the pickling solution referred to at Step (4). The whole of the case is, of course, immersed for the final pickling operation at Step (5).

A dull zinc solution of conventional formulation was used, the composition of which was as follows :

Zinc Oxide	$5\frac{1}{2}$	oz. per gallon
Total Sodium Cyanide ...	$11\frac{3}{4}$	oz. per gallon
Sodium Hydroxide ...	$13\frac{1}{2}$	oz. per gallon

Prior to use the solution was purified with zinc dust, sodium sulphide and activated carbon as follows :

First of all the cleaned storage tank that was supplied with the plant was filled with hot water (140°F.) to three quarters of the required final volume. The calculated quantities of sodium cyanide, sodium hydroxide and zinc oxide were then added slowly in the order given and stirred well until complete solution was effected. Zinc dust was then added at the rate of 1 gm. per l. (1-lb. per 100 gallons) and the contents of the tank stirred well for 30 minutes. Activated carbon at the rate of 3 gm. per l. (3 lb. per 100 gallons) was then added with further stirring for 15 minutes.

The solution was then allowed to settle for a period of 4 to 6 hours after which it was filtered into the clean plating tank using a filter coated with activated carbon and a suitable filter aid.

Finally, sodium sulphide at the rate of 0.125 gm. per l. (2 oz. per 100 gallons) was added in the form of a solution and the contents of the bath thoroughly stirred, after which the latter was ready for use.

Owing to the fact that the thickness of the deposit of zinc required on the interior of the case was different from that on the exterior, two separate rectifier circuits were used to supply current to the internal and external anodes respectively.

After adequate rinsing, passivation was carried out in a chromate solution of a special composition which was operated at room temperature with air agitation in order to produce as uniform a passive film as possible. Although the plant was fitted with a delayed set-down mechanism which provides for great flexibility should it be desired to alter the period of immersion at any time, it was decided to use a modified form of the conventional chromic acid/sulphuric acid passivating solution. The use of this solution enabled the rate of formation of the passive film to be slowed down and, in fact, very satisfactory results were obtained at an immersion time of 37 seconds. It was found that the most reliable method of controlling the composition of the passivating solution was to use a *p*H meter. The optimum *p*H for this solution was found to be 1.84 and the value was checked twice daily.

At a later stage subsequent to the removal of the cases from the plant, the interiors are coated with a lacquer of the phenolic-resin type. In this connexion it should be pointed out that one of the general requirements connected with shell cases is that the material of the case or any coating applied to it, must not affect or be affected by the propellant. Since it is believed that there is a possibility of the occurrence of some reaction between zinc and the propellant, it is customary to lacquer the chromated zinc deposit in case any bare spots of metal have been left during the passivating process.

Plating Racks

The major problem associated with the internal cleaning, pickling and plating of shell cases in an automatic plant is the design of a suitable rack, and the chief factors to receive consideration are :—

1. The incorporation of an internal electrode, suitably insulated electrically from the main framework which must be of opposite polarity.

2. Avoidance of excessive carry-over due to trapping of solution and provision of rapid draingage when lifting.

3. Prevention of trapping pockets of air or

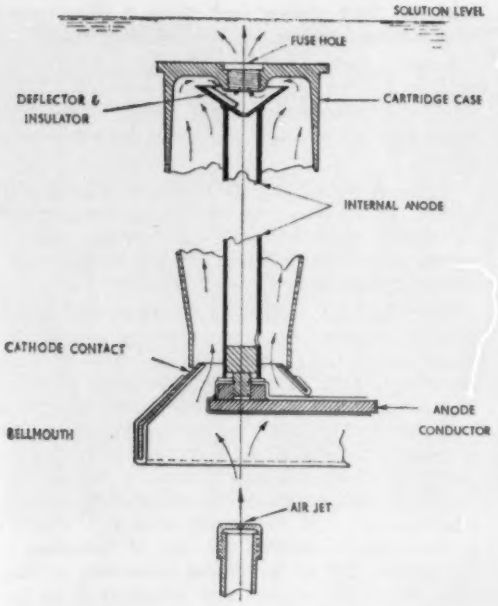


Fig. 4.—(above) Diagram showing section of shell case and rack.

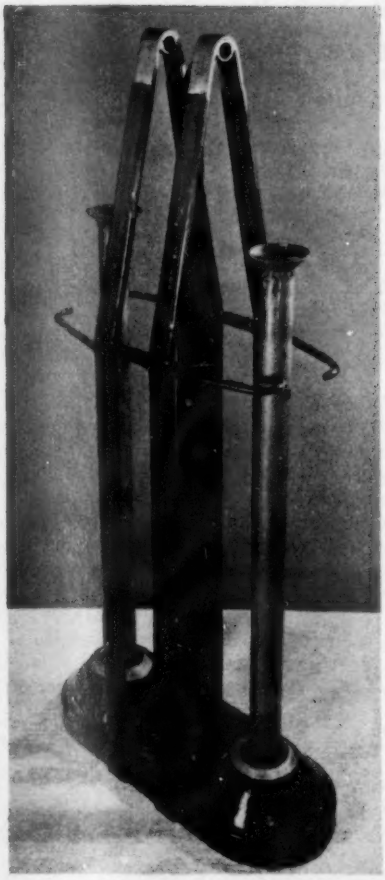


Fig. 5.—(right) General view of plating rack.

evolved gas when submerged, to ensure complete internal surface treatment.

4. To provide adequate flow of solution through the bore of the shell case to ensure full strength solution conditions, especially in the zinc plating tank.

5. The orientation of case or cases on the rack for conveyance and transfer through the automatic plant economically, without making the plant as a whole unduly large and costly.

The last feature should perhaps be given primary consideration, since it affects not only the actual rack design, but also the whole plant layout, and since the length of the most types of automatic plant, and in particular the Udylite return type, has a greater effect on cost than height or width, the vertical disposition of the cases is to be preferred.

Accepting that the shells should be held vertically, the next factor to receive consideration is whether to rack the cases with open mouth pointing upwards or downwards. Both systems have been used in the States with results which were far from satisfactory. One such plant with cases ' mouth down ' had a system of submerged jets of re-circulated solution positioned beneath the cases in each tank. The hollow internal electrode was flared into a bell mouth at the base below the mouth of the shell to " collect " the jet of solution and direct the flow through the electrode tube, which terminated in a cone shaped disperser with swirl vanes designed to discharge the solution flow against the head of the case to sweep any trapped air or gas away through the fuse hole.

This system did not prove very effective and it is not difficult to see why, if it is remembered that when an attempt is made to blow anything into the open mouth of a funnel, it is deflected back instead of passing through the narrow end.

After due consideration of the known methods previously employed it was decided to adopt vertical racking with two cases per rack.

Tests indicated that with ' mouth up ' the carry-over of solution trapped in the recessed base would be 100 c.c. per case, with virtually no satisfactory method of reducing this amount.

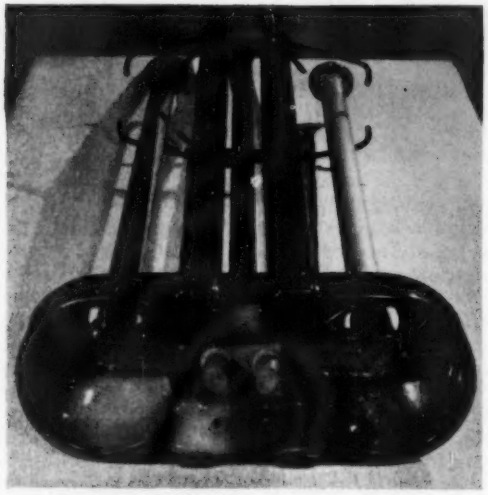


Fig. 6.—View of plating rack from below.

It was also evident that the time required to drain the bulk of solutions from the case through the fuse hole, during lifting, before transfer from tank to tank would necessitate a slow lift speed to avoid excessive splashing due to fall back after lifting clear of solution surface. At 20 ft. per min. lift speed, drain-out continued for 6.5 sec. after the base of shell case emerged from the solution surface, with unobstructed fuse hole.

It was therefore apparent that a ' mouth-down ' position would be most favourable, provided a suitable means could be devised to obviate the trapping of air and gases in the recess surrounding the fuse hole in the inverted shell head. After consideration and rejection of many ideas, a relatively simple method occurred to us, based on the theory of the " Air Lift " pumping principle. This conception appeared at first sight somewhat unreasonable—introducing air to remove air, but nevertheless, there is some truth in the old adage " set a thief to catch a thief."

By introducing a steady stream of air bubbles below each case and directing them into the mouth of the case by a flared bell-mouth, the resulting aeration of the contained solution causes a reduction in density relative to the solution outside the case, with the result that an upward flow is promoted.

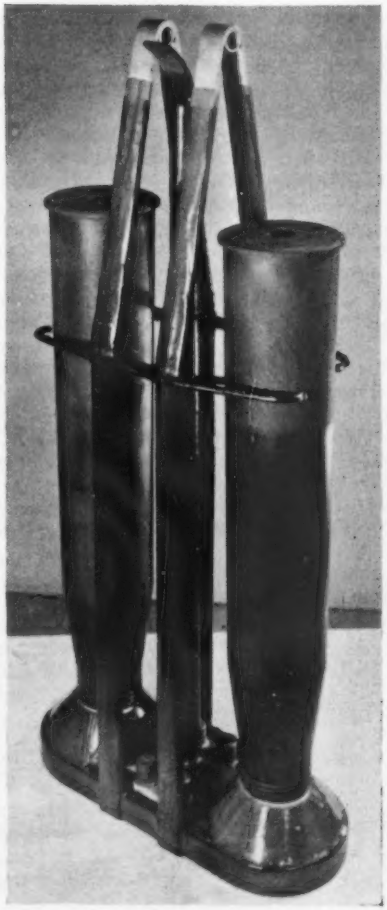
The internal electrode is capped with a simple inverted hollow cone projecting into the recessed head of the case, causing the solution flow to follow the internal contour of the head, converging towards the centre with increasing velocity to escape through the fuse hole, ' sweeping out ' any entrained air and gas.

A prototype rack was made and tested with full-size shell cases and proved that adequate cleaning, pickling and zinc plating on all exterior and internal surfaces, including the recessed head and threaded fuse hole were satisfactory and, in fact, provided a greater thickness of zinc deposit than was required by the specification. As previously mentioned, the specification called for 0.0004 in. and 0.0002 in. respectively on outer and inner surfaces.

The volume of injected air required to obtain these satisfactory results was found to be quite small, approximately 0.2 cubic feet per minute for each shell case.

Another very important feature of the rack design is the method of providing adequate ' catho-

Fig. 7.—Shell cases in position on rack.



dic ' contact between the rack and the shell case, without causing burning or otherwise marking the case. This has been achieved by allowing the mouth of the case to rest on a cone at the base of the rack and this cone serves a dual function in that it also ' collects ' the air bubbles and directs them into the mouth of the case.

Other rack design features worthy of mention are listed below :—

1. The internal electrodes or anodes of 1½ in. outside diameter and 0.10 in. thick solid drawn nickel tubing have a nickel cone shaped deflector welded to the top with insulation strips rivetted on as an extra precaution to prevent metallic contact with the cathodic steel case, while in addition there are external plastic-coated steadying guides attached to the main frame of the rack to centralize the case in relation to the electrode. The tubular electrode is attached to the rack frame-work by a screwed joint to facilitate replacement when necessary.

2. The cathodic contact for conducting plating current to the shell case is provided by the upper portion of the base cone which, for the most part, is plastic coated, the coating being stripped off over the required contact surface. The weight of the case is fully supported by this cone.

3. The main structual framework of the rack is formed by four vertical brass bars, brazed to the base frame carrying the cathodic cones and connected in pairs at the top to pivot on a horizontal bar attached to the sliding work carrier. This pivoting movement is to facilitate the loading and unloading of cases without removing the racks from the plant.

4. The connecting member between the cases of the two internal electrodes is welded to the central vertical feed bar, the whole sub-assembly being plastic coated.

5. Thus the rack consists essentially of two sub-assemblies, each independently coated with a double layer of plastic to minimize porosity.

The two assemblies are connected by a resin-based fabric-reinforced bridge plate bolted separately to each structure to avoid any possibility of a short circuit between anodic and cathodic members.

6. Anodic current is fed to the central conductor rod by flexible copper braid from a bronze shoe sliding between two flat copper conductor bars supported by the main plant structure.

From the foregoing it will be evident that the zinc solution was intended for continuous operation under conditions of moderate air agitation. The opinion was expressed at an early stage in the development work, that the use of air agitation would give rise to a rapid increase in the concentration of carbonate in the solution. Accordingly, some simple comparative tests were carried out to see whether this would occur. Three beakers, (a), (b) and (c) each containing one litre of cyanide zinc solution were exposed to the atmosphere. The solution in (a) was not agitated in any way, and that in (b) was stirred mechanically and the liquid in (c) was air agitated. Initially, the composition of the zinc solution in each of the three beakers was identical. From time to time an analysis of the solution was carried out in order to determine the concentration of sodium carbonate, caustic soda and sodium cyanide. All tests were carried out at room temperature. The results obtained from these tests are shown in both tabular and graphical form herewith. (*See* Table I and Fig. 8). It will be observed that there is very little difference in the rate of increase, irrespective of whether the solution is agitated or not.

Table I

Number of analysis	Constituent	(a) gm. per l.	(b) gm. per l.	(c) gm. per l.
1	NaOH	73.0	73.0	73.0
	NaCN	76.9	76.9	76.9
	Na_2CO_3	24	24	24
2	NaOH	68.8	69.0	69.0
3	NaOH	64.0	60.8	60.8
4	NaOH	16.4	8.4	12.0
	Na_2CO_3	99.5	98	100
	NaCN	76.0	74.9	73.5

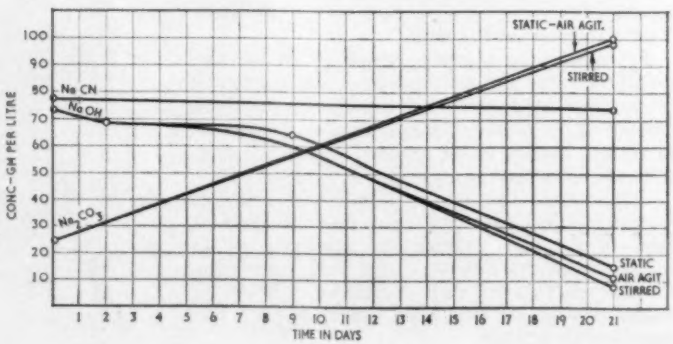


Fig. 8.—Graph showing variation in solution composition with time and with different types of aeration.

Table II

Name of Metal or Alloy.	Approx. Specific Gravity.	Approximate Composition (per cent).								
Hastelloy D.	7.8	Ni 90	Si 10	†	*Ni 90	Cu 3	Al. 1.5	Si. *±10		
Inconel	8.6	Ni 79	Cu 14	Fe 7	†					
Corronel B.	8.8	Ni 66	Mo 28	Fe 6	†					
F.V. Staybrite FMB Stainless Steel	7.96	Ni 8	Cr 18	Mo 2.75	Mn 0.5	Si 0.3	C 0.07	Fe Balance		
F.V. Staybrite 254 Stainless Steel	8.04	Ni 18	Cr 18	Mo 3.75	Cu 2.4	Ti 0.6	Mn 0.8	Si 0.4	C 0.07	Fe Balance
Nickel	8.9									
Mild Steel	7.83									

* Composition given by Mond Nickel Co. Ltd.
† Composition given by Handbook of Chemistry and Physics, Chemical Rubber Polishing Co.

Anode Material

The choice of material for use as an inert anode which could pass through all the solutions used in the sequence and yet not be attacked itself, or cause contamination of any of the solutions concerned, had to be made with considerable care. Accordingly, a series of tests was carried out on a number of materials, each of which had good claims to be used. First of all, the behaviour of the metals and alloys concerned was investigated under the following conditions :—

(1) Immersion in 10 per cent by volume sulphuric acid solution. Temperature 60 to 70°C. Time of immersion—varied.
(2) Anodic treatment in a dull cyanide zinc plating solution at 75 amp. per sq. ft. for various periods.

Table II gives details of the composition of the metals and alloys used in the tests.

Table III shows the loss in weight of the alloys expressed in milligrammes per sq. cm. per 24 hours.

Table III

Type of Alloy or Metal	Loss in weight in 10 per cent v/v sulphuric acid at 60-70°C. Milligrammes/sq. cm/24 hours.	Loss in weight when made anodic in zinc cyanide solution at 75 amps./sq. ft. Milligrammes/sq. cm./24 hours.
Hastelloy D	0.05	0.38
Inconel	1.40	0.316
Corronel B	0.097	0.201
F.V. Staybrite FMB Stainless Steel	7.50	1.19
F.V. Staybrite 254 Stainless Steel	0.20	0.927
Nickel	5.00	0.44
Mild Steel	5510 (5.51 grammes).	0.42

Table IV shows the correlation between the losses in weight of the metals tested in terms of the plant sequence, taking into account the relative immersion times in the sulphuric acid and zinc plating stages. The weight losses are expressed as milligrammes per sq. cm. per 100 plant cycles. Figures are given also which show the number of plant cycles necessary to reduce the anode wall thickness to half the initial thickness and the time taken for this wear to take place, assuming one pant cycle per hour in a 40-hour week, *i.e.* 40 cycles per week. For both these figures, an initial wall thickness of $\frac{1}{8}$ in. was assumed. It should be noted that these figures necessarily assume that corrosion of an even nature takes place.

The results of these tests indicate, taking various factors into consideration, that the best metal for use as an internal anode for the plating rack assembly is nickel.

Of the other metals on which tests were carried out, Hastelloy D and Corronel B exhibited the longest life, but they are virtually unobtainable.

Stainless steel, grade 254, was better than F.M.B. stainless steel and Inconel also possessed a good life. The drawback, however, to using these three alloys is that all of them contain chromium, which dissolves when the metal is made anodic in the cyanide zinc solution. The presence of chromium in a zinc solution, even in trivalent form, was regarded as undersirable. Apart from nickel, the only other metal on which tests were carried out was mild steel, which by comparison with the other metals possessed practically no life at all.

Since it was considered that nickel was the best metal to use as an internal anode, it was decided to study whether the addition of nickel to the zinc solution affected the cathode efficiency of the latter, the appearance of the deposit and the effect of passivating the zinc.

Table IV

Type of Alloy or Metal	Loss in weight in 10% v/v sulphuric acid at 60-70°C. Mgm. / sq. cm./ 100 plant cycles.	Loss in weight in zinc cyanide solution at 75 amps./ sq. ft. (Anodic). Mgm. / sq. cm. / 100 plant cycles.	Total loss in weight. Milligrammes / sq. cm. / 100 plant cycles.	Loss in diameter of anode in inches per 100 plant cycle	*No. of plant cycles necessary to reduce wall thickness of anode by half (assuming initially ¼" thick)	†Period taken to wear anode wall to half original thickness (assuming initially ¼" thick).
Hastelloy "D"	0.029	0.301	0.330	0.000033	190,000	91 years
Inconel	0.800	0.251	1.501	0.000096	65,000	31 years
Corronel II	0.172	0.055	0.227	0.000023	270,000	135 years
F.V. Staybrite FMB Stainless Steel	4.282	0.943	5.225	0.00056	11,000	5½ years
F.V. Staybrite 254 Stainless Steel	0.114	0.735	0.849	0.00083	75,000	36 years
Nickel	2.860	0.349	3.209	0.000028	22,000	11 years
Mild Steel	3150	0.355	3150.355	0.32	20	½ week

* For purposes of calculation it was assumed that attack on anode proceeds on the inside of the anode as well as the outside in zinc solution. This probably is not true.
† Assuming a rack does one cycle per hour, for eight hours per day, five days per week, i.e. 40-hour week and 52-week year.

As a result of the tests that were carried out, it was found that for a concentration of nickel as high as 1 gm. per l. the effect in an air agitated zinc solution was only to reduce the cathode efficiency to a small extent, as shown in Table V. :—

Table V

Current density in amp. per sq. ft.	Per cent Cathode Efficiency Air-Agitated Dull Zinc Solution	
	Not containing nickel	1 gm. per l. of nickel
20	100	94.5
40	100	90.0

The effect of nickel on the appearance of the deposit was found to be as in Table VI :—

Table VI

Concentration of nickel in gm. per l.	Appearance of Deposit	
	Low Current Density Area	High Current Density Area.
Up to 0.1	Slight brightening effect.	Slight brightening effect.
0.35	Milky deposit.	Milky deposit.
0.6	Milky deposit.	Black deposit.

When ascertaining whether the presence of nickel as an impurity in the cyanide zinc solution had any effect on the passivation of the zinc deposit, a solution containing 0.08 gm. per l. of nickel was used for the purpose of the tests. Plated panels were prepared from this solution and also from a similar one which, however, did not contain any nickel. These panels were subsequently passivated but no detectable difference in the appearance of the two sets of panels was observed.

Finally, the problem of the removal of nickel from the cyanide zinc solution was considered. According to the electromotive series, nickel should deposit by immersion on to zinc, as the following abridged table shows :—

Zinc	— 0.76	volts
Chromium	— 0.56	„
Iron	— 0.44	„
Cadmium	— 0.4	„
Nickel	— 0.23	„
Hydrogen	0.00	„
Copper	+ 0.34	„
Silver	+ 0.8	„

Accordingly, tests were carried out on a dull cyanide zinc solution containing 0.3 gm. per l. of nickel, zinc dust being used as the purifying agent. It was found that in order to remove the nickel, 5 gm. per l. of zinc dust was required, and the following treatment was found to be effective :—

(a) Pump to purification tank and raise the temperature of the cyanide zinc solution to 45°C.
(b) Add zinc dust (5 gm. per l. for every 0.3 gm. per l. of nickel present).
(c) Stir the solution for 15 to 30 minutes.
(d) Allow to stand for 4 to 6 hours (preferably overnight), maintaining the temperature at 45°C.
(e) Filter and return to plating tank.

The addition of sodium sulphide and/or activated carbon, did not improve the results obtained when using zinc dust and, therefore, the use of these materials is not recommended when removing nickel from cyanide zinc solution.

It is interesting to point out that from calculations made from Table IV one would not expect a concentration of 0.3 gm. per l. of nickel to be attained in the cyanide zinc solution until after the plant had operated for several years.

Some American Experience in the MECHANIZATION OF HOT-DIP GALVANIZING

THERE are approximately 250 galvanizing plants in the U.S.A., including all the captive plants and it would be difficult to find two with the same production requirements. The complete automation of hot-dip galvanizing is therefore impossible on a broad basis, but it has been found practicable to *mechanize* the process to a large extent.

The Malleable Iron Fittings Company of Branford Connecticut built a semi-automatic machine for galvanizing pipe fittings in 1945 and the design of this machine has proved to be very satisfactory. Very few repairs and practically no design changes have been required since it was first started, although it has been operating for 16 hours almost every day. The machine produces an excellent galvanized coating on pipe fittings individually strung on multiple prong racks. Practically all the major pipe fittings manufacturers in the U.S.A. are using machines of this type in their galvanizing departments today. However, not all products are suited to the rack process. A substantial number of items which cannot be handled on racks are galvanized in baskets going through the centrifugal process. The company therefore undertook to design a dual-purpose machine which could handle a broader range of products through either the centrifugal process or the rack process. Details of the machine were given at the 1959 meeting of the Hot Dip Galvanizers' Association Inc. by H. S. Hansen of Malleable Iron Fittings Company.

The objective of M.I.F. was primarily to build a machine that would fulfill a large percentage of the job galvanizer's requirements as well as its own. For this reason, flexibility of design was of the utmost importance and this has been achieved with the following features :

1. Practically unlimited dip in the spelter. The two machines built so far both have a 33-in. vertical travel. However, machines can be built with a 4½- or 6-ft. vertical dipping action. Length and depth of the kettle would be the only limiting factors.

2. An easily controllable cycle which—once it is set for a certain item—is completely automatic. The cycle is controlled by a programme timer which regulates the immersion time, the automatic washing action and the automatic skimming of the surface of the spelter before the basket emerges from the zinc bath.

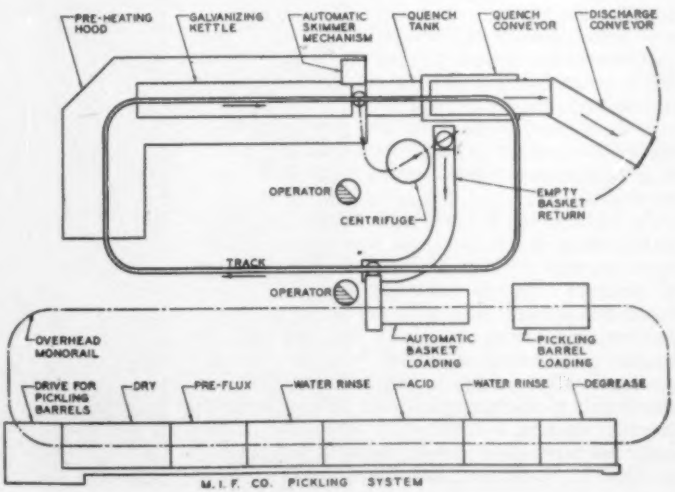


Fig. 1.—General layout of hot-dip galvanizing machine.

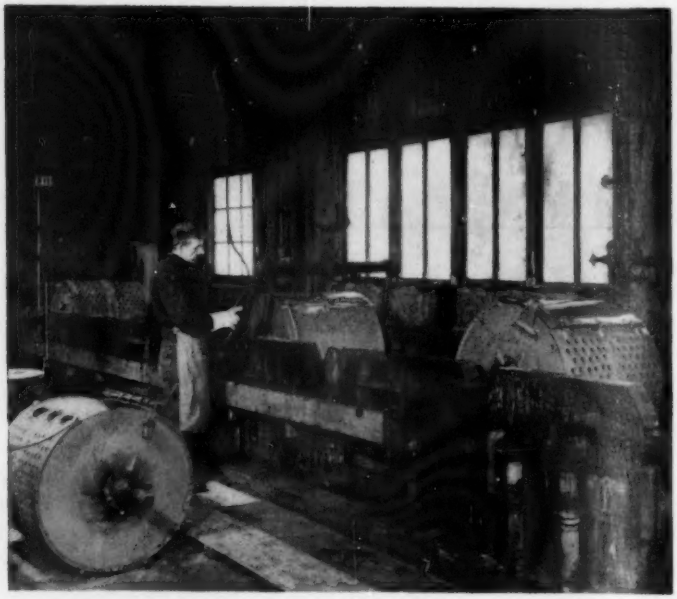


Fig. 2.—(left) Pickling system with rotating barrels.

Fig. 3.—(below) Basket loading and pick-up station.

3. Multiple tracks to facilitate handling of :
(a) Two or three different basket sizes for centrifugal work.
(b) Rack work of comparable dimensions.

4. The machines are built as a structural unit and may, if desired, be made portable. Some are mounted on wheels enabling it to be rolled away from the kettle. Others have been designed to be suspended from overhead tracks or to be picked up by overhead bridge cranes. In all cases it is possible to move the machine to such an extent that the kettle is completely accessible for drossing or other purposes.

5. The number of baskets immersed in the spelter at any one time may be varied from installation to installation in order to meet certain product and tonnage requirements.

6. It is possible to make the new galvanizing machine a part of a large plant-wide processing system, because it is built around a standard trolley conveyor.

In addition to flexibility of design and completely automatic cycling, the new machine offers larger tonnage per man-hour and improved quality of product. Figures indicating tons of product galvanized per man-hour will vary greatly from one product to another and from one company to another ; therefore it cannot be said that the machine will produce at one-half, one-third or one-fourth of the normal labour cost. However, in order to give a quantitative indication of the economic features, it can be mentioned that 3000 to 5000 lb. of product galvanized per man-hour would be a reasonable production to expect from items weighing less than 1 lb. each.

The new machine has built-in controls which allow all the important phases of the process to be regulated in order to achieve the quality desired ; these are immersion time ; washing cycle ; speed

Fig. 4.—(right) Completing transfer of basket from kettle to centrifuge.

Fig. 5.—(below) Items are dumped into quench conveyor after centrifuging.

of withdrawal of the items from the spelter ; spinning time ; and time in the quench water.

These operations are all controlled through electrical programme timers and controls. For this reason, requirements pertaining to coating thickness may be maintained consistently. The " human element " has been eliminated, drastically reducing the need for skilled labour. All cycles may be preset or prescribed by the foreman. Fig. 1 shows the general layout of one of these machines.

The material to be galvanized must be absolutely free of grease, scale, sand and oxides. At the plant of Malleable Iron Fittings Company the material is carried through the acid bath, the water rinse, the prefluxing tank and the drying stations in 10-cu. ft. Monel pickling barrels. These barrels are rotated in the tanks in order to obtain the most efficient pickling. In the drying stations, the items are dried from the internal heat received in the hot zinc-ammonium-chloride solution in the prefluxing tank.

When pickling is completed the items are dumped near the loading station in an open hopper or in a semi- or fully automatic loading chute from which they are transferred into the empty basket. The basket is placed on a gravity roller conveyor which is located below the main track. When the basket is loaded it is picked up (*See* Fig. 3) by the basket carrier, which will take it to the entrance end of the kettle.

At this point, the trolley supporting the basket starts to follow the track, thereby lowering the basket into the spelter as quickly as possible, yet slowly enough to prevent floating. After com-

(*Continued in page* 289)

SOME DETAILS OF THE VIBRATORY FINISHING PROCESS

VIBRATORY finishing is a method of metal finishing to replace rotary barrelling.

Hitherto, improvements have been confined to various methods of imparting additional movement to rotary barrels, but the vibratory finish is a new approach to the problem and is producing interesting results.

In the barrelling process, work and abrasive or polishing media, together with compound is loaded into a barrel which is revolved at a slow speed.

The action of the media in scrubbing the work during the slide period slowly produces the finish required, within the limitations of the process, and it is accepted that useful work is only done on the layer of sliding material as shown in Fig. 1.

As the work is necessarily done in a closed container, precautions have to be taken against pressure build-up and it is not possible to observe the process except by stopping the machine and opening up the barrel.

The vibratory-finishing process consists of imparting a three-way vibratory motion to a mixture of components, abrasive or polishing media and selected compound, and an open container.

For the majority of de-burring applications, the container is loaded with a quantity of abrasive chippings, components and compound. The container is then vibrated. The speed of vibration and also the amplitude can be varied depending upon the size and shape of the components and the severity of the work to be performed.

During the period of processing, the whole of the components are subjected to an accelerated scrubbing motion due to the relative motion of individual load components shown in Fig. 2.

As the mass in the container behaves more or less as a liquid, the work is kept in suspension in the media and is virtually free from the force of gravity. In consequence, there is no risk of distortion of fragile articles by load pressure or the effects of the tumbling slide as in barrel machines.

The fact that the action is not confined to the layer of sliding mass, but that processing takes place throughout the volume of the container, considerably reduces the processing time.

Complex or tubular shapes do not necessarily limit the effectiveness of the vibratory process. Most shielded surfaces and concave recesses can now be reached with the proper selection of media, whereas tumbling, by its very nature, cannot be effective on shielded or interior surfaces.

Very large or extremely heavy pieces can be attached to a fixture for finishing. Both laboratory tests and production runs have proved that the time is cut drastically when the fixture is supported by the stationary frame in the machine. The time cycle is further reduced when the fixture is supported by the rim of the vibratory container.

In addition the ratio of media to work can be reduced and there are savings in compounds.

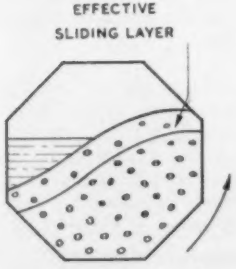


Fig. 1 (left)—Diagram illustrating normal barrelling

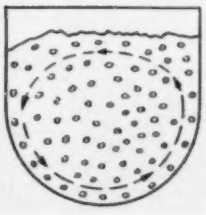


Fig. 2 (right)—Diagram illustrating vibratory finishing

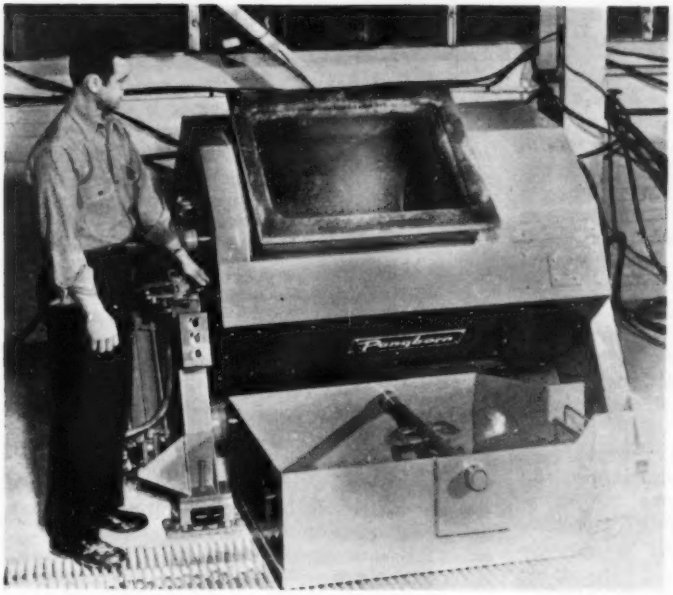


Fig. 3—General view of Pangborn vibratory-finish machine

The severity of the action can be varied and depends on :—

Shape and size of media.
Type of compound.
Shape, size and material of component.
Ratio of media and component to work.
Variation of amplitude and frequency.

Media

Media used in conjunction with the process consists of :—

Synthetic abrasives. General-purpose chip of fine crystalline fused aluminium oxide of varying sizes. Preformed shapes, such as triangles, cylinders, starforms, diamond shapes, arrow heads, etc. of bonded and kiln fired. Aluminium oxide or silicon-carbide grain.

Organic media. Broken shells, leather, rubber, small wooden shapes, etc.

Metallic media. Hard and soft steel shapes and balls.

The selection of suitable media depends upon the finish and also the size of holes or constrictions into which the media could become wedged. To prevent this, the media should be large enough not to enter the hole or less than $\frac{1}{3}$rd the size of the diameter of the hole. It should be of such a size as to cover all recesses and in some cases it may be necessary to mix two or more sizes. Generally speaking, the larger the size of media, the more rapid the cutting action. Organic media has little or no cutting action and is used chiefly for polishing. Metallic media in soft shapes can be used with abrasive compounds for deburring, while hard shapes are used for polishing.

Compounds

Compounds can affect the cutting action in two ways :—

1. A soapy compound with high lubricating properties will reduce the cutting action and produce a foam which will assist the cleansing. An abrasive compound with little lubrication action will assist the cutting action of the media.

2. Acid compounds speed up the action of ferrous parts covered in scale and can be used as a brightener on brass parts. Mild alkaline compounds are of use with aluminium components or where there are slight traces of grease or oil on components. Neutralizing compounds are for use after an acid compound or for cleaning etc.

Suitable compounds are available in various mixtures and of the following types :—

Abrasive compounds : Used with aluminium-oxide chips or bonded preforms.

Burnishing Components : Used for colouring or burnishing and made up in suitable compositions to suit all types of metal.

Cleaning, neutralizing and non-abrasive compounds : Used with aluminium-oxide chips and effective in de-burring, radiusing, cleaning and neutralizing after acid descaling.

Descaling compounds : Acid base to facilitate the rapid removal of scale and carbon deposits.

Rust-preventative compounds : Used as a last rinse or in a deep tank to afford temporary protection.

Machine

The Pangborn vibratory finish machine is being manufactured under licence by the Hepburn Conveyor Co. Ltd., Rosa Works, Wakefield, who are also setting up a processing department for the purpose of demonstrating the machine on submitted samples and to train the personnel of firms who instal machines into the correct method of application, selection of compounds and media.

The machine consists of a rubber-lined open-top container mounted on air cushions. The vibratory action of the container is achieved through the use of an eccentric shaft, mounted on a sub-frame and carried through air cushions by the tilting cradle.

The air-cushion support has provision for automatic levelling and amplitude control and supplants spring-suspension systems subject to fatigue and obviates vibration at spring frequencies.

The eccentric shaft is mounted on oversize vibration-resistant bearings, coupled through an annular flexible coupling and manually adjusted variable-speed drive, to a totally-enclosed electric motor.

Air-cushion foot mountings can also be provided which make possible the complete elimination of floor vibration.

The container assembly tilts through 120 deg. for discharge and is operated by an air cylinder, or in the case of the larger machines by a hydraulic system.

As shown in Fig. 3, a control box with push button and air controls built in a convenient position is provided with interlocks to prevent operation until the air pressure is available at the air cushions and the container in the correct position. A process timer can also be fitted.

The whole machine is of heavy-duty welded steel construction, stress relieved and convenient and positive methods of controlling both the frequency and amplitude of the load and is equally effective with a part load as when fully loaded.

The main control panel contains a magnetic starter with anti-plugging reverse and speed indicator.

Operation

To process a batch of components, the container is fitted with a correct proportion of media, compounds and components in the operating position.

After connecting the air supply and adjusting the container level to the correct position, by means of a valve on the control box, as shown by an indicator, the motor is switched on.

The period of processing may be controlled by an automatic timer and since the container has an open top the progress may be inspected while the work is in progress.

After processing the container is covered with a perforated plate with water connexion so that the compound may be emptied out, retaining the media and components and water can be added for a short washing or rinsing process if desired. The electrical controls are interlocked so that the machine cannot be vibrated with the container on the tilted position.

The components and media can then be emptied and separated and the machine is then ready for re-loading.

To obtain full efficiency, the media and compounds should be carefully selected and the Hepburn Conveyor Co. are able to offer supplies which have been thoroughly tested and found most suitable for vibratory finishing.

Full details are available, based upon experiment and research which has been going on for a long period in America and Hepburn Conveyor Co. are in consequence, able to offer spectacular results as compared to barrelling. Speeds of from 4 to 10 times as great are common place and it is claimed that work has actually been turned out completely processed 100 times faster than conventional barrelling.

Vibratory finishing can be used for the following operations :—

Cleaning, descaling, de-burring, grinding, radiusing, fine finishing, colouring, burnishing.

It is suitable for all metals and alloys and many plastic and ceramic items.

The machine is claimed to give a wider range of application, larger loads and reduced time cycles, resulting in significant savings.

It easily handles parts too delicate to finish by other methods, it works on shielded areas and on interior surfaces, it does coarser jobs faster and better with impressive cost reductions. It is suitable for forgings, stampings, castings, machined and processed parts.

The machine is suitable either for severe cut down (0.025 in. of stock has been removed from stainless-steel forgings in 30 minutes) or for delicate work (laminations 0.006 in. thick x 4 in. diameter have been deburred without distortion).

At the present time, there are in production 1½-, 6- and 18-cubic foot machines to be followed by 3- and 12-cubic foot sizes.

The company's processing department will be pleased to accept samples and return these with data on the machine used, pieces per load, frequencies, amplitudes, media and compounds together with details of time cycles and production rates.

THE METAL FINISHING CONFERENCE

SCARBOROUGH, APRIL 27 to 29, 1960

A Report of the Annual Conference of the INSTITUTE OF METAL FINISHING

(*Continued from page 235, June, 1960*)

ABSTRACT NO. 9

STUDIES ON THE SURFACE TREATMENT OF ALUMINIUM AND ZINC

by D. B. Freeman and A. M. Triggle**

THE object of the work is to survey and compare the types of chemical treatment available for treating zinc and aluminium for protective purposes. Electrolytic processes have not been included although in the case of aluminium, anodizing has been incorporated as a reference standard.

Comparative corrosion and adhesion tests have demonstrated the value of chemical surface treatments for improving the bare corrosion resistance and adhesion of paint to zinc and aluminium. Recent developments have enabled architectural green coatings to be produced on aluminium with consistant colour and chromate-fluoride coatings to be applied on high-speed strip lines.

It is now possible to correlate the colour of chromate coatings on zinc with the ratio of the hexavalent chromium to the other anion present. The best results are obtained when this anion is sulphate. Yellow chromate films of very good protective power can be produced from comparatively dilute solutions. Colourless chromate films can also be obtained from these solutions by adding ammonium sulphate to the processing solution.

The paper is divided into two sections, aluminium and zinc, and much experimental information is given.

The results obtained for the aluminium, demonstrate that all of the chemical conversion coatings are of value in promoting the adhesion of paint to aluminium and increasing corrosion resistance where service conditions are severe.

In the selection of a process for a given application factors such as cost, plant considerations and the nature of the materials to be processed may limit the choice. Other things being equal however, a general indication of the fields of application for the various types of process investigated is given below.

Application.	*Process.*
Decorative purposes	Chromate-oxide or chromate-phosphate.
Paint base	
(a) multi-stage paints	Chromate-fluoride
(b) simple immersion plants	Chromate-oxide
Mixed metal production	Zince phosphate or modified chromate-fluoride
High-speed strip lines	Chromate-fluoride

As has already been stated, the work was not intended as a comparison between chemical coatings and anodic coatings. The choice between the two surface treatment methods will be governed not only by the cost which would favour the chemical method but also by such factors as abrasion resistance, where anodizing would be expected to show a considerable advantage.

The results from the zinc experiments indicate that the best over-all protection against corrosion, the chromate film, from the CrO_2-$Cr_2(SO_4)_3$, is the one to choose. It has the advantage that it can be applied cheaply as its working solution is comparatively dilute. The paint adhesion for this film is not quite as good as that of a phosphate coating but is certainly a vast improvement over untreated material, whether the paint be air-drying or stoving. Of the colourless films considered, that from the CrO_3-$Cr_2(SO_4)_3$-$(NH_4)_2SO_4$ solution is the best for corrosion protection and adhesion.

All types of treatment dealt with in this paper have a beneficial effect. Treatments of the types described are likely to find increasing application, particularly where a high order of corrosion protection is required. Further work in this field is likely to be directed towards (a) the development of treatments whose paint adhesion properties are even higher (b) a more fundamental approach to an understanding of the coating mechanism and film constitution (c) the development of colourless films with higher Cr content.

* The Pyrene Co. Ltd.

DISCUSSION

MR. E. S. SHAW (I.C.I. Ltd., Paints Division), dealing with the chromate-phosphate treatments for aluminium, said that the authors correctly stated that the problem of colour control with sludge formation applied to coatings of dark green colour, but not to the more popular light shades of green which were more widely used in British industry. A large installation at his works had been working on the lighter shades of green for over six years, often with three-shift working, and the chromate-phosphate solution had not yet been discarded ; a small amount of sludge was removed at the annual clean out.

When preparing aluminium for painting, the chromate-phosphate treatment formed very little sludge indeed. Another plant which was processing strip was currently forming sludge at the rate of only 2 in. per million square ft. processed.

The chromate-phosphate process had an advantage over the chromate-fluoride in that it would treat fairly resistant surfaces without preliminary etching, a point of some importance in the industry. With the oxide skin on the surface, the chromate-fluoride treatment required an etch which might mean an additional tank. The chromate-phosphate treatment should be included in the list given in the author's conclusions as a paint base in multi-stage plants and simple immersion plants.

The discussion of results in the paper called for comment. He submitted that when treatments were examined by practical experience and standards there was no point in increasing the severity of a laboratory test to show discrimination. In other words, if paint adhered so well to these treatments that it could not be removed in an ordinary scratch test it was a little unfair to indent the metal before starting to scratch. The thin chromate-phosphate coatings in Table III received bad ratings on impact and bend tests. He would like to see that related to practical use, because those coatings had proved extremely useful for many years and gave adequate paint adhesion on a great variety of industrial equipment, from washing machines to supersonic aircraft. Similarly, the thin chromate-fluoride coating showed up badly in the humidity test in Table IV. That was again contrary to his own practical experience with coatings of this type. He suggested that these laboratory tests should be correlated with industrial experience.

Treating Zinc Surfaces

With regard to zinc, a statement was made which the authors might enlarge upon, namely that a new brushing solution had been developed for the treatment of zinc surfaces, but solutions of that nature had been on the market since the early 1930's. With regard to colourless films on aluminium and zinc, he would like to mention a very real difficulty concerned with inspection. His company had marketed a colourless process particularly for aluminium, and their American colleagues had put out a colour test so that people could see whether or not it had been done. Unfortunately this was a destructive test, and the problem then arose of patching a hole in an invisible coating. This had led to harsh words and ill feeling before the test had been finally abandoned.

DR. F. A. CHAMPION (British Aluminium Co. Ltd.), confining his remarks to the aluminium part of the paper, asked the authors to give some information on the method used in measuring film thickness. He wondered, in referring to paint adhesion, how much of the differences drawn between the chromate-fluoride and chromate-phosphate types of film were in fact a matter of film thickness, as the chromate-phosphate films were thicker than the chromate-fluoride.

On the corrosion tests, he felt that an important

(Left to right) Mr. R. J. Brown (British Motor Corporation); Mrs. Stein; Mrs. Brown; Dr. W. Stein (Joseph Lucas Ltd.); Mr. R. L. Yeates (Docker Bros. Ltd.).

environment had been left out. The tests were concerned with salt spray and humidity, whereas probably the most important environment for these coatings in practice was the industrial atmosphere, which was not represented in the authors' tests, but could in his experience give a different comparison of the different types of coating.

Comparing Coatings

On the question of comparing coatings, he thought that it was unfair for the authors, in their discussion of their results, to pick out coatings for particular purposes. No one would want to have several lines on mass production for different types of coating. It was a considerable merit in a coating if it could be used for different purposes by some adjustment of process. Colour had to be considered. Green was generally a much more acceptable colour when exposed without further coatings, and if it was possible to get that sort of colour and satisfactory paint adhesion the question of film thickness might come in.

The authors also stated that spray application gave a satisfactory coating at a lower film thickness than dip application. It would be interesting if they would explain that and give any reasons for it. Was it a matter of the physical action of the spray, and what sort of spray was involved? Was it a matter of exposure of metal to a mist or to some actual impingement which affected the attack on the metal, or was it a matter of the oxygen-content of the solution, or simply a matter of wishful thinking, in that one could not afford very long exposure times with the spray cutting ?

Could the authors also give some clue to the costs of the ion-exchange process?

In considering the corrosion tests, it was necessary to bear in mind that this method of assessment was really related to appearance, and did not give any information on the effect of exposure. It was desirable to have more information of the progress of the effects, rather than a statement of the effect at an arbitrary time.

Finally, the authors had in their test used pure aluminium S1B, and also NS4. He had found that there was much more call, where alloys were concerned, for treatment of the aluminium-magnesium alloy NS3 rather than NS4. In his experience that gave very similar results to S1B, and the results could probably be applied to this alloy for the applications in question.

Effect of Impurities

Mr. T. van der Klis (Royal Dutch Airlines) asked first, whether the authors could give any indication of the effect of impurities in the chemical solutions which were used for the different processes, and in particular say what was the effect of the impurities on the corrosion-resistance of the coatings?

Second, the same question might be of even more importance for the rinse water. It was his experience that the purity of rinse water for light metals in aircraft applications was of great importance, because small amounts of chloride ions in the rinse water had a bad effect. Did the authors have the same result in their experiments? In the range of solutions which were investigated, were there compositions which were less susceptible to impurities than the types most generally known and used on aircraft parts?

Third, with regard to the temperature of the rinse water, had the authors any indication that a hot-water rinse or a hot-water wash during a prolonged time caused a sealing effect, and did they think that such a wash might be desirable ?

Mr. C. D. S. Bridgett (R.E.M.E. War Department) criticized the authors' anodizing procedure and did not think that they had obtained the best results at 30°C., so that he did not find the results given in Table V surprising. The window test for adhesion seemed too prone to influence by the human element and he would prefer a direct method. He was not familiar with the semi-soak test which was referred to, but it seemed to test the properties of the paint rather than of the surface underneath the paint.

In the chromating of zinc he had had no difficulty in getting good results and complying with DTD 923, and he had used the method for 15 years or more, but he had never been able to produce a golden yellow and had obtained this only on cadmium. Had the authors any experience of the use of etch primers on the top of passivated zinc surfaces? There did not seem to be general agreement on their suitability.

Mr. K. P. Bellinger (Conversion Chemical Corporation) congratulated the authors on an orderly study of films on aluminium, which was something that he had not previously seen in the literature. An application for the chromate on aluminium which should be mentioned was its use prior to porcelain enamelling. It replaced chemical oxidizing on continuous strip treatment and was to be preferred because in forming operations prior to the enamelling and after treatment the die wear was insignificant compared to the oxidized finish. The same practical significance could not be attached to the study of chromate films on zinc. A study of both the panels and the formulae would indicate that the films would have been very soft when wet. That was a disadvantage of the original Andersen chromate film. For bulk work so treated in industry there was a liability to bruising in the treating operation, so that the commercial application was limited.

Coating weights

Mr. T. C. Tapp (John Summers & Sons Ltd.) had the impression that the coating weights on

the test specimens were rather outside those normally applied for paint pre-treatment. He suggested that the attempt had been made to apply paint to chromate films which were themselves in the self-protective category, and these were outside the accepted paint pretreatment levels. With zinc and the paints which had been used, it was well known that short-oil alkyds gave rather poor paint adhesion to a zinc substrate, even if pretreated.

MR. A. W. BRACE (Aluminium Laboratories Ltd.) commented on the reference in the paper to the interest in chemical conversion coatings on aluminium as a sort of general anti-glare self-colour treatment for using the aluminium for all sorts of applications, particularly in the building field, but said that there was no mention in the paper of how long the chemical-conversion coating could be expected to retain an attractive appearance in various environments. This would probably vary, and it would help to have data on the subject.

He also pleaded for more study and collaboration between the organic paint technologists and the pretreatment specialists on the question of adhesion, because the sort of problem which came to the notice of those who had to use these things was that many of the new organic coatings left them with the problem that it was necessary first to take some metal, then put a conversion coating on it, and then put a coating on to secure adhesion of the newly developed coating, and then there was the latest development on the top layer, and that presented some problems. What was even more serious, however, was the situation where a pretreatment process was installed which worked quite well with several organic finishes and then gave very bad results with a different type of system. That was a problem in the case of a plant which had to handle a number of different types of finish. At the moment there was very little information available as to how different processes worked, so that there were conflicting claims.

He thought that more attention ought to be paid to developing a really satisfactory process as a pretreatment for what the Americans called " porcelain enamelling," which in this country was usually referred to as " vitreous enamelling." None of the processes available was completely satisfactory ; even the best had definite practical drawbacks.

Anodic Coating Thickness

Finally, he made a plea for anodizing. A fact which was frequently overlooked was that it was not necessary to have a thick anodic coating to give paint adhesion. There was a process whereby only 0.25 micron of anodic coating was used, and it was an extremely good paint base and very economic in comparison with other processes.

DR. S. WERNICK (Consultant) said that whenever colours were considered the question of colour matching and the maintenance of colour standards arose, and here they were depending on the maintenance of the hexavalent chromium/sulphur ratio to a very considerable extent to maintain a given shade of colour. There were frequently difficulties in that connexion.

Not very much had been said about the economics of the various processes which the authors described. Cost did raise its ugly head. Had the authors any information on the relative costs of the different processes which they described?

Author's Reply

MR. D. B. FREEMAN, in reply, agreed with Mr. Shaw that the chromate-phosphate type of coating, when putting on a light green, the amount of chromate being reduced, would not present a serious problem with the amount of aluminijm going into solution, and that the problem only became serious when the customer required a deep green colour. Mr. Shaw had said that chromate-phosphate coatings required no etching, and Mr. Freeman agreed that this was so ; he had no desire to deprecate the use of chromate-phosphate coatings under paint. Mr. Shaw had made a point on the adhesion tests that it was not necessary to go to great lengths to get failure if the normal tests were passed satisfactorily. The adhesion tests used by customers might vary. One of his customers used an adhesion test in which an aluminium strip which had been painted was bent double and hammered out along the crease, and the crease was then examined for any flaking of the paint film. The customer insisted on that standard being reached, and none of the conventional adhesion tests would be of any use in that case.

He agreed with Mr. Shaw's point about the successful use of low-coating-weight chromate-fluoride coatings. The authors now thought that the coating weights which they had chosen for the particular process used in their work were too low. Finally, he was well aware that cold brushing treatments had been available for many years. He was not sure whether they gave equivalent performance to a conventional hot phosphate or whether they were applicable to all zinc surfaces.

Dr. Champion had asked a question about the determination of film thicknesses on aluminium. The method which the authors had used was to strip films in concentrated nitric acid. Provided that no attempt was made to strip too many that was quite satisfactory, but a further point was that that method of stripping was applicable only to a recently formed film. This applied to both chromate-fluoride and chromate-phosphate types. A coating which had been lying around without

stripping for a week or more was very difficult indeed to strip. One method which had been found useful was stripping in molten potassium nitrate.

Mr. Freeman agreed with Dr. Champion that the corrosion tests presented in the paper did not take urban atmospheres into consideration, but outdoor exposure tests were now in progress to take care of that.

On the question of why a thinner chromate-fluoride coating was satisfactory if applied by spray, this was something which was under investigation at the moment and he could not give any information at the present stage. As to the cost of an ion-exchange unit used for these processes. it would be quite a big capital item at the outset, and he felt that this expedient was justified only on a very large plant. However, after the initial capital outlay the running costs should be negligible.

Dr. Champion had also raised the question of the aluminium alloys. As originally conceived the programme was to have included half a dozen common aluminium alloys, but when they calculated the number of test panels this would involve the answer had been astronomical, and so they had had to reduce the number of alloys down to two.

Mr. van der Klis asked about the effect of impurities in these types of process. This would vary with the type of process. Chromate oxide was fairly tolerant. Phosphate treatments could be sensitive to some impurities. Chromate-phosphate was fairly tolerant, but with the chromate-fluoride type of process the presence of phosphate could have disastrous results.

On the question of rinse waters Mr. Freeman agreed that chloride in the final rinse was bad. The authors had found that the very best final rinse was from dilute chromic acid in dionized water or, if dionized water was not available, simply dilute chromic acid. As for the temperature of the rinse water, with the chromate-fluoride type of process a prolonged rinse in hot water was bound to lead to some bleaching action which would be deleterious. As for the sealing action of a hot rinse, the only case where this would be applicable would be with the chromate oxide type of coating.

Mr. Bridgett had criticized the authors' anodizing procedure. Whatever anodizing procedure had been adopted, it would not have been to everybody's taste. They had found the window test quite satisfactory provided it was used not on just one place on the panel but in several places. As for the soak test, he thought the results as tabulated suggested that this showed up considerable differences in the pretreatment rather than in the paint itself. The colour obtained from the Andersen-type chromate passivation would probably vary with every type of zinc surface. He did not think there was any value in using an etch primer on top of a chemical treatment. Etch primers had their field, and the other things had their field. The extent to which these overlapped was sometimes exaggerated and with a chemical conversion treatment a conventional primer was to be preferred.

Two speakers had raised the question of porcelain enamelling. A great deal of work had been done in America on the use of chromate-fluoride processes for this purpose. Some were used in this country, but the position had not yet been finally sorted out.

Mr. Brace had asked how long some of the treatments described would stand up under various environmental conditions. It was very difficult to say. One example on a railway-station roof had been given, a green chromate-phosphate coating which after five years still looked remarkably good, and the atmosphere in a railway station with steam trains was drastic.

In reply to Dr. Wernick, the maintenance of the hexavalent chromium/sulphate ratio did not present a serious problem, because both these things could be determined quickly by conventional chemical analysis.

Abstract No. 10

THE USE OF ALUMINIUM PASTE IN ORGANIC FINISHES

by G. E. Gardam and A. W. Brace**

ALUMINIUM paint is a very familiar finish for metals and this paper briefly describes the production of the pigment and outlines its unique characteristics which arise from the pigment itself which consists of fine flakes of metallic aluminium. The starting point for its production is aluminium powder made by atomizing molten high-purity metal with a hot-air blast ; shredded aluminium foil is also sometimes used. The fine powder is reduced to flakes by a stamping or hammering action in the presence of stearic acid. The final thickness of the flakes can be controlled by adjustment of the time of milling. The average diameter of the flakes decreases as they become thinner, because the work hardening during the reduction eventually causes embrittlement and breaking. The rate of work hardening is less with high-purity aluminium, therefore commercial aluminium pigment is invariably made with rather pure metal, at least 99.5 per cent.

Particular reference is made in the paper to flake thickness, leafing and deleafing phenomena, reflectivity, emissivity and durability. On durability, mention is made of experimental results

* Aluminium Laboratories Ltd.

The Silvercrown group (left to right) : Mr. R. Clegg (sales manager); Mr. W. T. Lee (Chief Chemist) ; Mr. G. Schmerling (Managing director); Mr. A. Walmsley (N.W. area rep.) and Mrs. Walmsley; R. Haywood (B'ham area rep). Following are Mr. A. M. Woisberg (Vice-president, Technic Inc., U.S.A.) and Mr.K. P. Bellinger (President, Conversion Chemical Corp., U.S.A.).

which show the standard paste to be more durable than standard lining and extra fine lining pastes which have greater water covering area. This is because standard paste offers the maximum path of resistance to moisture penetration. These tests also showed within practical limits the higher the pigment content the greater the durability. A subsequent paper reported that alkyd and phenolic resin vehicles give particularly durable paints when pigmented with aluminium paste. Better protection was obtained from finishing coatings having high leafing properties. Mention is also made that considerable merit has been found in the use of non-leafing aluminium in priming paints for structural steelwork in conjunction with zinc oxide or basic lead sulphate. Several such formulations gave a performance equal or superior to the red-lead-linseed-oil primer used for comparison. There is also evidence from tests carried out at Aluminium Laboratories Ltd. and elsewhere that a leafing aluminium top-coat has a better durability over a non-leafing aluminium primer than when applied to the conventional types of primer.

The formulation of finishes based on aluminium paste pigment is then discussed and some typical formulations are listed. Some of the requirements of a suitable vehicle are :—

a) not highly viscous
b) water content below 0.1 per cent.
c) freedom from strongly reactive, polar or acid groups.
d) freedom from lead dryers.
e) high surface tension.
f) compatability with white spirit.

Other requirements of the vehicle are dictated by normal paint-technology considerations, for example, water resistance, distensibility, ease of application.

There is much experience of satisfactory media for ready-mixed paints. Coumarone resins have proved particularly well adapted for aluminium paint because they are practically neutral ; ester gum, terpene resins and petroleum resins have also been used with success. Phenol-formaldehyde resins are also very suitable but alkyd resins need to be carefully selected for low residual acidity. A recent patent covers the addition of the reaction product of an organic amine and stearic acid to such paints, for the purpose of neutralizing excess acidity and thus widening the available choice among alkyd resins. Paints formulated from any of these resins also contain a proportion of drying oils. Tung oil has been found especially suitable, although a proportion of drying oils such as linseed or boiled linseed oil can be added.

Bituminous vehicles can be used where their protective qualities and low cost recommend them, provided they are somewhat tolerant of a proportion of white spirit. The completeness of the leafed film largely precludes the use of coloured bituminous paints but some coloured formulations are appended.

Deleafed aluminium paste is much used in the polychromatic paints which consist of clear, coloured nitro-cellulose or similar media. The pigmentation ratio is low : if a paste of uniform flake size, free from aggregates is used, very attractive sparkling results are obtained, but it requires great skill to obtain uniform and reproducible effects and repair is especially difficult.

Very attractive finishes resembling a hammered metal surface can be obtained using deleafed paint in a transparent vehicle containing two immiscible solvents.

A recent developement of outstanding importance is the modification of aluminium paste so that it can be held stable in the resin droplets of a water-based emulsion paint. During application the water component dries off or soaks into the substrate and the aluminium flake then leafs to the surface of the organic film, thus imparting the usual silvery appearance. This paint is especially suitable for inexpensive treatment of paper and card for the packaging and wrapping trade.

DISCUSSION

MR. C. BUTLER said that in dealing with the preparation of the aluminium paste, mention was

made of the addition of a further quantity of stearic acid to the normal paste in order to stabilize the properties of the pigment. How much stearic acid was present in the final standard aluminium paste and could some indication be given of the way in which this addition stabilized the pigment?

Reference was made at the end of the paper to the development of a new type of aluminium paste suitable for use in water-based emulsion paints. This was an interesting development and further information on it would be welcome, as would any comments by the authors on the production of an aluminium paste for use in conjunction with the newly developed water-dispersible resins. These new resins would appear to have a future industrially as a basis for dip-coatings, and a dipped aluminium primer would be a very interesting commodity. He agreed that aluminium as a pigment was a very useful weapon for the paint technologist, and the performance of aluminium coatings was outstandingly good ; but there were several problems encountered when aluminium paste was used. The authors dealt clearly with the mechanism of leafing and explained that there was a great limitation placed on the driers which could be used in the formulation of aluminium paints. It would thus often be very difficult to produce an aluminium paint with satisfactory drying properties, especially when using a medium calculated to give outstanding durability, such as an alkyd medium. This was partly due to the limitation on the drier which could be used. A more serious and significant difficulty, however, was caused by the leafing itself. There seemed on the top of the film to be a continuous aluminium barrier which prevented the normal drying process of the film by stopping the oxygen getting into the film.

Deleafing

The authors referred to the very interesting subject of deleafing. If it were desired to make a bright aluminium paste, deleafing must be avoided and anything which tended to deleaf the paste must be prevented. The authors suggested that one of the things which deleafed a paste was the acid or residual acid of the medium used. If a flake of aluminium had a coating of stearic acid, he found it difficult to understand why that coating should be removed by the presence of any residual oil. He would have thought that stearic acid was relatively stable towards a similar acid in an oil. In practice, things did not work out so easily as the authors suggested. It was possible to formulate aluminium paints of media of exactly the same acid value, and one would be bright and remain bright for a year and another would be dull within 48 hours ; in other words, one retained its leafing properties and the other was deleafed. A possible explanation was not so much the acid value of the medium concerned but perhaps the presence of small amounts of free polyols.

One of the most serious problems which the paint manufacturer encountered when using aluminium paste was the production of a lasting bright surface which would stand up to normal wear and tear, such as for the cab of a transport lorry. The normal bright aluminium paints were susceptible to damage by slight abrasion, and even to that caused by rubbing with a handkerchief. In a normal painting process a varnish would be put over it so that this would not be important ; but, because of the nature of the leafing aluminium paste, and the floating to the surface of the layer of aluminium coat with stearic acid, there was presented a surface which was not suitable for the application of varnish or other coating because the adhesion was small. Was any work in hand to devise an alternative coating for aluminium paste which would still give the leafing properties but give the paint manufacturer a chance of overcoming this difficulty?

Damage by Abrasion

On the question of damage to an aluminium film by slight abrasion, it was interesting to note that this damage was far less pronounced when dealing with a stoved film, even though the mechanism of leafing was the same. It might be assumed that the stoving bound the leaves in a good deal more tightly. Another interesting point, if only an academic one, was that aluminium paste was perhaps the only pigment in existence which exercised an effect on the medium, which had the result that a medium which tended to be brittle would, if painted with aluminium paste, become less brittle.

Aluminium Paints on Wood

MR. C. D. S. BRIDGETT (R.E.M.E., War Department) said that it was well known that almost all the heat-resisting paints contained aluminium, and it would be of interest if the authors could say more about this. Second, aluminium paints were often used on woods which were resinous to keep the resin from coming out. If the aluminium leaf came to the top, how did it stop the resin lifting the paint?

Author's Reply

MR. A. W. BRACE, in reply, said that Mr. Butler had elaborated on some of the points made in the paper, from the point of view of the paint manufacturer. Mr. Brace could not offer him many solutions. Mr. Butler was probably aware that the stearic acid content was limited by a British Standard. There was in the specification for aluminium paint the requirement of a maximum

grease content of about 3 per cent, and, since stearic acid was the main item concerned there, that imposed a limitation. The normal addition of stearic acid was rather less than that, and it was primarily a question of making the pigment a little more stable and enabling it to store better and generally to retain its characteristics a little longer.

All that he could do on the question of water-base coatings was to call attention to the literature reference given in the paper. Some work was being done in this connexion, but it was not yet finished. The problem primarily was that the development had been mainly in North America, and one always met with a certain number of problems in finding exactly equivalent materials in this country, but there was no doubt about the basic principle. He had had no experience of the water-dispersible resins, but was interested in the subject and he hoped to have an opportunity of considering it. The fundamental problem was that if water could get at the aluminium pigment there would be trouble with deleafing. The principle was to wrap round the aluminium paste, a film which would be resistant. It might be possible to adapt that principle to the water-dispersible resins provided there was no reaction between the water-dispersible resin and the agent used to coat the aluminium film with a protective layer.

He agreed with Mr. Butler that the question of residual acid was puzzling, because in his experience the behaviour varied from one type of medium to another. The suggestion that the polyols were responsible might be a fruitful one and worth following up. There was need for more work in this field. because at the moment there were contradictions which were not easily explained. The authors did not know anything about the abrasion resistance of the aluminium surface. It was a problem of which they were conscious, but at the moment his company had done no work on it and he had not seen in the literature any indication that anyone else was dealing with it, but it had to be tackled.

What had been said about aluminium and iron oxide was relevant. Work had been done which showed that if there was aluminium paint on rusty steel and it was struck sharply with a steel tube there could be an appreciable flash from it. That might not be so readily achieved if the iron oxide pigment were just mixed with the aluminium paint. There was the possibility of a small thermic reaction, but the amount of material involved was not enough to cause anxiety.

Mr. Bridgett referred to heat-resistant paints. Various people had produced compositions based particularly on silicones which appeared to be effective. Some heat-resisting paints seemed to depend on burning away the vehicle and leaving a skeleton. That was moderately effective at low temperatures.

On the question of paints on wood, what was normally recommended was the use not of leafing aluminium but of non-leafing aluminium, a more or less characteristic pigment which covered over irregularities in the wood and a vehicle which would take care of the resin. On top one could put either a conventional colour coat or a leafing top-coat.

THE CHAIRMAN (Dr. Wernick) remarked that platers were probably envious of a finishing process which had the feature of leafing and also of the manner in which it was possible to spread such a small amount of metal over such vast acres of territory. He noted from the figures that a gram of aluminium could cover 30 sq. ft. in single-flake thickness, and he calculated that under those conditions about 4 oz. would cover a room as large as that in which the meeting was being held. The flakes were very much of the order of thickness of chromate, about 0.001×10^3 in. If the authors could be persuaded to do something in the chromate field approaching what had been done in the aluminium field, they would earn the indebtedness of the whole of the finishing industry.

Abstract No. 11

AN ASSESSMENT OF COATED STEEL SHEETS AND THEIR USE IN INDUSTRY

by F. H. Smith and T. C. Tapp**

IMPORTANT new developments are taking place in the manufacture and application of coated steel sheet and the many different kinds of coated steel sheet which are now available to manufacturers, as well as some of the technical aspects of the production control of plastic-coated sheet are described in this paper.

The quality of a finish is very largely a matter of close control of the modern continuous plants installed in steel mills. Instrumentation plays an important part and by this means coating uniformity and thickness is under close control at all times. A comprehensive table in the paper shows the principal characteristics and applications of the many coatings now available.

Of the recent developments, the plastic-coated steel sheet has probably caused most interest, and as the details of this product are now well known, comment in this paper is confined to quality and application. Considerable information is given concerning the specifications required for values of

* John Summers and Sons Ltd.

adhesion in terms of peel strength and the use of the L'homme and Argy tensile tester, well known in the textile industry and adapted for testing laminates by peeling the top film back at 180 deg. is described. Other tests carried out on random samples of material include soak tests in which the specimens with cut edges are completely immersed in water at 20° C. for ninety-one days. Subsequent tests by the L'homme and Argy method must show no deterioration in bond strength. This test is important for applications in humid conditions for which the material must be free from pin-holes and the adhesive unaffected by water. Another test involves ageing the material at 75° C. for periods of twelve weeks and sometimes as long as twenty-four weeks. In this test the bond strength must not deteriorate by more than 20 per cent.

Some typical results of tests taken on a variety of p.v.c./steel laminates, including American and Japanese materials, are given in a table.

The choice of finish is dealt with and also the protection of the sheared edge and the underside of the sheet. The more usual coating for the reverse side is Bonderizing, zinc chromate priming, electro-zinc coating or hot-dip galvanizing. The galvanizing must be of the ' tight-coated ' quality, from continuous processes, so that breakdown between steel and spelter is avoided. The electro-zinc coating is usually thin, but is gives adequate protection during the fabrication of the article. However, when plastic-coated sheets are used in outdoor applications, further treatment of the zinc surface is necessary.

Most types of plastic-coated sheets may be stove enamelled on the steel side, providing the stoving is carried out at a temperature no greater than 300° F. and a time no longer than 20 minutes.

From this paper appear three important matters to be considered when assessing the advantages on using plastic-coated sheet or strip.

1) The laminate must be well bonded. This means that not only must the p.v.c. coating remain adherent under a straight peeling test, but also it must show good adhesion after cold working such as occurs during a tensile test.

2) The user should take full advantage of the various properties *i.e.* colour, embossing, print, corrosion resistance.

3) The user should adapt the fabricating techniques in order to obtain the best service performance from the material. It has been found that the best results have been obtained when an article has been designed with plastic-coated sheet in mind.

Hot-dip aluminizing is being carried out by a number of companies in the United States, using continuous units similar to those for hot-dip galvanizing. It is claimed that this coating is more resistant to outdoor exposure than zinc. Corrosion resistance at higher temperatures is good and for this reason it is being used in the U.S. in the manufacture of car silencers and, to some extent, in building. These sheets can be welded using special techniques and can be formed, bent and even drawn to a limited extent.

Other decorative and protective coatings are described, such as zinc, copper, nickel, chromium and brass. Most of these coatings are ductile and capable of being bent, formed and deep drawn. They are used in the manufacture of domestic equipment and automobile parts.

There is a surprisingly large variety of coatings now available on sheet and strip steel and an attempt has been made in this paper to describe those in common use and to give examples of the many applications.

Problems arising in the application of these materials are fast being overcome and it seems that in the near future there will be a need for a more comprehensive assessment of their potentialities.

DISCUSSION

MR. W. E. MARTIN (BX Plastics Ltd.) suggested that it might be a matter not so much of the plastic coating of steel as of the metal coating of plastics. The authors had omitted to point out that this plastic-coated steel product, though not new in terms of years, was new so far as the quality which had recently been achieved in Europe was concerned. The product had originally been developed in the United States but had not found so many uses or had such an obvious potential as in Europe. That was probably because it had been taken up in a big way in Europe, whereas in the U.S.A. it had been taken up largely by non-steel companies. John Summers had been the first major steel-sheet producers to go into the question of the lamination of plastic films.

Another point was that in the realm of metal finishing this was perhaps the first time that film lamination had become a process of some commercial significance. There might be other film laminates to metal which would follow the examples of p.v.c. People were already trying to put polyethylene and certain polyester films on to metal of various kinds to achieve a variety of results.

P.v.c. was chosen to go on steel largely as a compromise. It seemed to have the best properties available of any commercial film. What did the authors think that the ideal qualities would be of any new plastic film yet to be discovered? It seemed clear that the plastics industry was in a state of flux. New plastics were coming out almost every week, and it was possible that people would design these polymers especially to suit the properties required for the coating of sheets. Lamination

at the moment was done only on very large-scale equipment, and only people in the sheet steel industry were capable of doing it properly. Was there in the authors' opinion a way of doing this job on a small scale? Could it be done in smaller works which took ordinary sheet steel and did this lamination process on it?

MR. R. M. C. LOGAN (Metal Containers Ltd.) said he had intended to raise the question of the amount of pioneering which had been done in Europe, but Mr. Martin had answered this by saying that the Americans had been the first but had not developed so quickly as on this side of the Atlantic. Reference had been made to plastisol-type coatings. Was it possible that the film type of coating was superior to the plastisol type on sheet metal from a permeability point of view? This was important if either of the products was used for domes or tanks.

MR. C. D. S. BRIDGETT (R.E.M.E., War Department) expressed interest in the statement that zinc-coated steel was used for petrol tanks. He had had a lot of trouble with them, but there were many authorities in America and in this country who said that zinc-coated steel should not be used where a high grade of petrol was stored.

MR. C. FRY, speaking from the point of view of the paint industry, felt that something should be said in support of p.v.c. and other coatings not applied at the mill. There was a great deal of truth in what Mr. Smith had said about the advantages of laminates for some purposes. In light engineering fabrication methods were being devised for dealing with the problem of assembling the sheet, cutting it and so on without too much trouble from the welding process and the bare edges, but it was obviously possible to put on whatever p.v.c. coatings were wanted as an organosol or plastisol, and for some purposes it would be desirable to have a great deal of flexibility in the formulation. With an organosol it would be possible, within reason, to have any colour desired, but to vary the colour of the sheet supplied in such a form might be more difficult. It would be possible to adapt the formulation in other ways. Organosol coatings, and probably plastisol coatings, could be made with a very wide range of plasticizer content, even going down to no plasticizer and using it purely as a paint, with all the adaptability of being able to use it in that way and also being able to use existing equipment.

Another point was that if the p.v.c. was put on in this probably difficult form as an organisol, it would be possible to use economic film thicknesses. Perhaps the authors would explain why the laminated material had such a high film thickness, because for many purposes that did not seem to be necessary from a protective point of view. After all, p.v.c. was a good protective coating, and acrylic finishes 0.001-0.002 in. thick gave satisfactory protection.

Could the authors explain why some paints adhered very well to electrodeposited zinc and others did not?

Authors' Replies

MR. F. H. SMITH, in reply, said that if asked what he would regard as ideal qualities for a new film he could make a number of suggestions. They had been asked whether they could put scent in the film so that it would smell nice, and whether they could make a luminous coating which could be seen in the dark. The decision had been made to use p.v.c. because at the time—and he thought that this was still true—it appeared to have most of the characteristics required, with one major exception, heat-resistance. They were finding every day that with p.v.c. as a laminate on steel, if heat was applied on the p.v.c. side it was rapidly carried away by the steel beneath and therefore the p.v.c was able to stand up to very much higher temperatures than it could by itself; but it would be preferable to have a plastic which would withstand higher temperatures.

As regards coating on a smaller scale, in the U.S.A. this was being done in a packaged type of plant, but it was not done in the same way as in this country, where two large companies were producing it straight off, taking a large coil of steel and putting on a large coil of p.v.c. in the hope of producing it on a price and quality basis which could not be beaten in any other way. In addition, by producing it in this large way there was greater possibility of quality control. The research which had had to go into this project was not related simply to the plant, which in itself was an expensive project, but, what was equally important, to ways and means by which the material could be fabricated and ways and means by which it could be quality controlled. That was fundamental, and it was only recently that it had been possible to get down to a uniform, consistent product. He did not think that that could be achieved with small units.

Mr. Logan referred to pioneering. While America had started off with sheet-by-sheet processes, this country had started with coated sheet material in coil, and it was that form of pioneering which had perhaps led to development being faster than in the United States. This country had also developed the multi-cell process of electrolytic zinc coating on steel, and this was a much more flexible process than was possible on the units used in the U.S.A. These units were very similar to the tinning lines. The plant was limited in the thickness of the material which could be passed

(*Continued in page* 289)

Mechanizing Hot-Dip Galvanizing

(*Continued from page* 275)

pleted "cooking," the basket is washed up and down through the flux blanket. After the washing, the basket is totally submerged while the automatic skimmer skims the flux blanket away from the exit end of the kettle. The basket is then immediately withdrawn from the spelter up through a flux-free and oxide-free surface. Finally, the basket is automatically disconnected and set off at the exit end of the kettle. From this position, the operator transfers the basket into the centrifuge by means of a transfer mechanism. Switches and control buttons to control all operations of the machine are conveniently located on the handle of this transfer mechanism.

Once the basket is located in the centrifuge the operator pushes one button on the transfer handle which starts the following cycle ; (a) the lid of the centrifuge closes, (b) an adjustable timer applies power to the centrifuge motor for a pre-selected number of seconds, (c) when "timed out" a pneumatically controlled brake is applied, bringing the basket to a complete stop, (d) finally, the lid is opened again. The basket is now transferred to the dumping mechanism which loads the material into a quench conveyor and the empty basket is returned to the loading station where the process starts all over again.

The speed of the quench is adjustable to enable the time in the quench water to be controlled, so that the items will be dry when they return to the tote buckets. This prevents the formation of white rust.

The number of men required to operate one of these machines varies with the production requirements. Two is a normal crew. One of these men takes care of the transfer of the baskets from the kettle to the quench ; the other looks after the loading of the baskets. Certain products lend themselves to fully automatic loading ; the entire process may therefore be handled by the operator on the transfer mechanism. In other cases, it may be necessary to position each item in the basket. In these cases more than one operator may be required at the loading station in order to fulfil certain tonnage requirements.

The foregoing description covers the centrifugal process only. With the rack process, racks are loaded and go through the spelter exactly the same way as the baskets, but instead of being transferred to the centrifuge, they continue to follow the track which guides the racks through the tank located at the exit end of the kettle. In order to prevent the items from sticking to the racks, these are vibrated during the quenching. Finally, the items are dumped onto the discharge conveyor, the empty racks travel to the loading station, and a new cycle begins.

Conclusion

Mechanization of the hot-dip galvanizing of small and medium sized parts is now definitely practicable. Actual experience with this new machine has shown many advantages including the following. Production per man-hour has been increased substantially ; quality and uniformity of product can be closely controlled ; less dross is produced ; the need for skilled labour has been reduced and general working conditions have been improved considerably.

I.M.F. Conference

(*Continued from page* 288)

through it and was not so easy to control with coatings thicker on one side than the other. The multi-cell process, developed in this country and now used on the Continent as well, was much more flexible and would coat anything from a very thin sheet to a comparatively thick plate.

Mr. Logan had also referred to film permeability, presumably in relation to what was normally put on inside, for instance, a drum. Experience was that a film could be more homogeneous and far more free from pinholes than a coating which was put on in manufacture. He would ask his colleague Mr. Tapp to deal with that point.

MR. T. C. TAPP said that in doing so he would also reply to Mr. Fry, who had referred to the difference between the film used by the authors and the organosol or plastisol film. A good deal of work on the subject had been done by the steel research body in this country, and they had decided that the vinyl film, particularly for large parts, was a better product from the point of view of permeability and other characteristics than an organosol or plastisol film. The authors agreed that the small producer or package plant could work with organosol more easily than the big user and that it was a more adaptable material in that way, but having regard to the technical characteristics which the drum maker, the furniture maker and others wanted, they believed that the vinyl film was very much superior. It was not true that the colour and other characteristics were more flexible in one than in the other. In their own production they could offer any colour that anyone could think of ; there was no limit to the colour or the pattern. If someone brought them snake skin or elephant hide and wanted material coloured and embossed to an exact match they would produce it, whatever the end product required. That might be possible in organosol and plastisol as well, but it was not a limitation in vinyl film.

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TRV/638

FINISHING
NEWS REVIEW

CYANIDE IN EFFLUENT

Company Charged with Exceeding 10 p.p.m.

WHAT is thought to be the first prosecution brought under the L.C.C. General Powers Act, 1953 was heard last month by the South Western Magistrates Court sitting at Battersea Town Hall. Certain facts emerged during the course of this hearing which may not be generally known and which could be of some significance to electroplaters operating in the administrative area of the London County Council.

The defendants in the case were the Atlas Plating Co. Ltd. against whom it was alleged by the Battersea Borough Council that on two stated occasions earlier this year they permitted matter to enter the sewer contrary to London County Council regulations. A plea of not guilty to the first allegation and of guilty to the second was entered.

The admitted facts were that on a sample taken on January 13 a concentration of 30 p.p.m. by weight of cyanide as CN was found and that on March 28 a concentration of 600 p.p.m. by weight was found. It was established that the Prosecution was not required to show that any negligence or criminal intent was involved but needed merely to establish the facts. Mr. F. W. Bush, B.Sc., F.R.I.C., a principal scientific officer in charge of the section of the London County Council's Scientific Laboratory carrying out analyses of effluents, was called by the Prosecution as an expert witness, and stated in evidence that the L.C.C. had set a limit of 10 p.p.m. for cyanide in effluents. He asserted that under the conditions obtaining in a sewer this concentration could result in a concentration of hydrocyanic acid gas of 1 part in ten thousand which had been established as likely to cause serious injury to health after an hour's exposure.

Mr. Allan Lipfriend who appeared for the Defence, in the course of his cross examination, asked whether it was generally known that concentrations in excess of 10 p.p.m. were likely to be injurious and to a further question from the Bench, Mr. Bush stated that this figure had been quoted for several years in the Annual Report of the Scientific Adviser, which was an L.C.C. Publication.

At this juncture a plea of guilty to the alleged offence on January 13 was put in.

In the course of his plea for abatement of penalty, Counsel for the Defence stated that his clients normally treated all their cyanide bearing effluent with hypochlorite which was able to reduce the cyanide content to 8 p.p.m. It had transpired, however, that the use of a proprietary solution for stripping nickel resulted in the presence of nickel cyanide in the effluent, and that in this combination the cyanide was unaffected by the hypochlorite treatment. Now that this fact was known, the stripping solution would be disposed of by means other than discharge to the sewer and special equipment was being installed to ensure that future effluent would never contain more than 4 to 5 p.p.m. of cyanide. His clients had certainly not been aware that a concentration of 30 p.p.m. was injurious to the health of sewage workers.

The Court imposed a penalty of £5 in each case with an award of costs of £35 to the Battersea Borough Council. The offence carries a maximum penalty of £20 and £10 per day for continuing offences.

BETTER PLATING ON DIECASTINGS

B.N.F.M.R.A. Hold Conference in Birmingham

A MEETING was called last month by the British Non-Ferrous Metals Research Association at the Botanical Gardens, Edgbaston, to provide an opportunity for drawing the attention of buyers and designers, particularly in the motor industry, to the improved plated finishes which are being developed for zinc-alloy die castings and to give the plater a chance to discuss the difficulties that arise in their application. Mr. R. J. Brown, chief materials engineer of the British Motor Corporation, who is a member of the council of the Association, was in the chair.

Mr. Brown opened the meeting by saying that for many years the British Non-Ferrous Metals Research Association has concentrated its work in the metal-finishing field on studies of nickel/chromium plating aimed at developing finishes which will have improved corrosion resistance on outdoor exposure. The first step has been to ensure an adequate thickness of nickel undercoat, and still better corrosion resistance can be achieved by increasing the thickness of the chromium layer which is applied to the nickel undercoat to take advantage of the inherently high corrosion resistance of electrodeposited chromium.

Before the meeting was thrown open to the assembly, Dr. Edwards, the Head of Metal Finishing section of the B.N.F.M.R.A. talked about an investigation which had been made into the causes of the blistering of die castings and the results of the service tests made on die castings plated with improved coatings of chromium.

He said that it had been a matter of some controversy for many years whether the blistering was the result of corrosion occurring from the outside of the plating or whether it is connected with some inherent property in the die casting itself. The researches of the B.N.F. have shown fairly conclusively that this blistering is a corrosion phenomenon arising from the attack of polluted atmospheres on the nickel/chromium plating.

Several examples, shown at the conference, indicated that the thicker chromium coatings applied under the right conditions do improve the corrosion resistance over that of the conventional nickel/chromium plated article even when the conditions of

(*Continued in page* 292)

PREPAINTED ALUMINIUM STRIP FOR VENETIAN BLINDS

A TYPE of outside aluminium awning was introduced to Britain by Luxaflex Ltd., the venetian blind manufacturers, at a special exhibition held at the Building Centre in London. Made from pre-painted aluminium strip, specially treated to resist corrosion and weathering, the awnings are of two main types—fixed and retractable. They can be used outside shops and buildings, as carports and patios, and the basic painted strip from which these awnings are produced can also be easily adapted for use as facia, wall cladding, walk-away covers, room partitioning and pure decoration.

An especially interesting use of this material is the sun louvre, a fixed awning designed to provide shade from direct sunlight inside commercial and industrial buildings.

Demonstrations were also given of the different types of aluminium venetian blinds available. These included "Audio Visual" blinds (which give complete darkness, and can be used when showing films); outside blinds, which are manipulated from inside a room; draw drapes, slats hung vertically and drawn like curtains; venetian blinds in a wide combination and variety of colour, and aluminium linen finish blinds in four colours, pink, grey, green and lemon.

BRITISH FIRM TO MAKE CONDUCTOR ROLLS FOR FRENCH TINNING LINE

THE Head Wrightson Machine Co. Ltd., a subsidiary of Head Wrightson & Co. Ltd., is manufacturing 23 copper conductor rolls, valued at £53,000 for the French firm Ets. Dujardin and Cie. These rolls, 24 in. in diameter with a face width of 46 in., will form part of an electrolytic tinning line to be supplied to the Phenix Steelworks in Belgium and built under the licence from the Aetna-Standard Division of Blaw Knox.

Since solid drawn copper tubing of 24 in. diameter could not be obtained, it was necessary to find a means by which the roll barrel could be formed by bending copper plate of 1 in. thickness. Head Wrightson were able, after considerable research, to develop a technique for the production of a homogeneous longitudinal weld along these shells. Having produced the shells, the rolls were built up by inserting phosporbronze shafts to which supporting webs had been welded.

By means of these rolls the plating current of 60,000 amp. at 20 volts is transferred from a heavy busbar system into the strip as it passes into the cleaning, pickling and plating tanks. In the future the plating current will be increased to 120,000 amp. at 20 volts with the addition of more tanks.

Head Wrightson has supplied similar copper rolls to the Steel Co. of Wales for their electrolytic tinning line at Velindre.

Better Plating on Diecastings

(*Continued from page* 291)

exposure are as severe as in the middle of London. Dr. Edwards went on to say that there are some practical difficulties to the immediate adoption of these finishes. Longer periods of plating will be required or higher current densities, both measures requiring alterations to automatic plating lines and both of which are bound to influence the cost of the article.

During a recent visit to the United States, he was unable to obtain a great deal of evidence about the benefits of duplex nickel plating as regards the service life of components, though in many accelerated corrosion tests this type of plating showed up very well. Alternative finishes being examined include double layers of chromium and undercoats of nickel-alloy plating, but some delay before the results of this work are available, is inevitable, since the only satisfactory criterion is a lengthy period of outdoor service.

The discussion that followed Dr. Edwards' excellent paper was somewhat disappointing. Very little constructive criticism was offered and few suggestions made, around which future research programmes could be planned. The main feeling of the assembly was that apart from any inherent properties associated with die-castings, the designer had a lot to answer for, in that he seldom sought the advice of a plater before finalizing the shape of an article.

components

Insufficient attention paid to the pretreatment of articles and infrequent sampling of solutions in automatic lines also contributed more than was generally appreciated to the production of inferior plating, but a representative of the motor manufacturers said that until such time as a process was developed that he could instal immediately in his plating line, more should be done to educate the motorist in the care of chromium plating. Dr. Edwards' comment on this was that little evidence had been found to support the theory that cleaning greatly enhanced the life of chromium plating.

Two instruments were on show which allow accurate determination of nickel and chromium thicknesses to be made, the B.N.F. plating gauge and the B.N.F. coulometric meter. The plating gauge has now been proved in industrial trials to give nickel thickness readings consistently to within 0.0001 in., while the coulometric meter is a new instrument developed for measuring very thin chromium deposits. Unlike the plating gauge, it is destructive of the coating, removing the deposit electrostatically from an area about $\frac{1}{4}$ in. in diameter. In addition to determining chromium, this meter can b-applied to many other kinds of electroc deposited coatings.

Electro-plating Firm Adds Seven Members to "25 Club"

A FIRM with an enviable record for keeping its employees happy is Fescol Ltd., the electro-chemical depositors and engineers (North Road, London, N.7). The firm has remained free of labour disputes since it was founded 40 years ago, and more than 50 per cent of the present employees have been with the firm for ten years or longer. One in every six has been a Fescol man (or woman) for more than 25 years.

On April 20, the firm held a lunch in London for its "25-Year Club" at which seven new members were introduced, bringing the total membership up to 35. This club was started some years ago by the directors of the firm, for employees with more than 25 years' service. At the lunch, which had to be held at a local restaurant since the club is now too large to meet in the Fescol boardroom, the seven new members were each congratulated by the managing director, Mr. F. B. Strachan and presented with a clock in recognition of their long service. Among the new members were Mr. C. W. Hay, works manager at the Port Glasgow factory, and Mr. W. Chapman, manager of the machine shop in the London works.

The main activity of Fescol Ltd. is the electro-deposition of hard-wearing metals such as nickel and chromium on machined or cast metal components.

The process is used mainly for increasing the durability of components, but is also valuable as means of building-up worn or damaged parts.

D.S.I.R. GRANTS FOR RESEARCH

During the year 1959, over 360 applications for research grants were received by the Department of Scientific and Industrial Research and of these, 295 were awarded, totalling £2,232,000, against 163 (£1,090,000) for 1958. These grants, for the purchase of equipment and employment of assistants and other aid, are normally spread over a period of 2-4 years and show an increase in every branch of science except mathematics, which is in step with the expansion in the number of awards for post-graduate training; research studentships rose by a fifth to 928 and over 250 advanced course studentships were awarded during the year compared with 184 in 1958. Some of the awards to universities and technical colleges are as follows;

Steel Research

£36,000 to Sheffield University for work on the transformation of metals to enable Professor A. G. Quarrell and his colleagues in the department of Metallurgy to purchase new apparatus for the study of the structure, composition and properties, both microscopic and macroscopic, of steels. The research programme includes a study of the fracture surfaces of various cast steels, a more precise determination of the role of alloying elements, structural changes during the working of iron-manganese-carbon alloys, creep properties, the constitution of slags and slag-metal reactions and other problems significant to the steel industry.

Microscopy

A great advance in the field of metallurgical research, using electron-transmission microscopy, recently made by workers at the University of Cambridge, makes it possible to follow, by cine-techniques, the arrangement and motion of dislocations when a metal foil is strained to breaking point. Microstructures down to atomic scale can be observed as well as what happens when a pure metal is suddenly cooled from a high temperature, and how nuclear radiation damages the crystal structure. Workers in this field of research include Dr. P. B. Hirsch of the Cavendish Laboratory, whose work is supported by a grant of £18,730, and Professor A. H. Cottrell, of the Department of Metallurgy, Cambridge, who was granted £15,000 for electron microscopical study of metallurgical problems.

Chemistry

Two grants have been awarded each over £20,000 for the purchase of the Metropolitan Vickers Mass Spectrometer M.S.9, which distinguishes between simple ions of the same integral mass but differing constitution ; the spectrometers will be used for molecular studies by Professor Sir Christopher Ingold of University College, London, and Dr. R. I. Reed, at Glasgow University. Professor G. O. Jones of Queen Mary College, London, has also received a grant of £13,000 for spectroscopic work at extreme infra-red wave-lengths.

METAL FINISHING SUPPLY HOUSES TO OFFER ELECTROPOLISHING PLANT

IT has just been announced that M.E.P.P. Ltd., the electro-polishing specialists who are the licensees for the processes developed by Battelle Institute, U.S.A., the Jacquet-Hispano Suiza Group of France and the Elektrolyse Gesellschaft m.b.H., Germany, have recently concluded separate agreements with W. Canning Ltd. and R. Cruickshank Ltd. by which the three concerns will supply the complete range of solutions, standard plants, and specially designed equipment offered by M.E.P.P. Ltd.

M.E.P.P. Ltd. is the only organisation in the U.K. offering a complete range of plants and chemicals for electro-polishing ferrous and non-ferrous alloys ; these have been proved under production conditions for over ten years in polishing and deburring stainless steel, stainless iron, brasses, gilding metals and aluminium alloys. Continuous progress by M.E.P.P. within its international group of companies has resulted in a substantial demand for its ready mixed chemicals and standardized plants and more recently there has been a wider scope for large units. The use of fully automatic and semi-automatic machines is envisaged in the immediate future and the wide experience of W. Canning and R. Cruickshank will be utilised in their design and manufacture.

PLASTIC-COATED STEEL COLD ROOM

CARTER Refrigerations and Air Conditioning Ltd. of Birmingham, have used "Stelvetite," the plastic-coated sheet steel, to line the "Everest" cold room recently installed at the shop of Mr. F. N. Darley, a Wolverhampton butcher. The walls, ceiling and door exterior are panelled with 16-gauge light-green Stelvetite with a glossy, non-toxic finish produced exclusively by John Summers and Sons Ltd. of Shotton, Chester. The Carter "Everest" cold room has a high gloss white rustless metal exterior with rounded corners and a door mounted on 18-in. chrome ball-bearing hinges with a roller-bolt fastener ; a cooler maintains the right humidity for meat storage with temperatures down to 28° F. and an automatic de-frosting system operates at least twice every 24 hours to ensure the cooling coils are free of frost.

Stelvetite was also a prominent display feature by James and Tatton Ltd., iron and steel stockholders of Hanley, Stoke-on-Trent on their stand at the North Staffordshire Chamber of Commerce Jubilee Exhibition, Hanley Park, Stoke, from May 18 to June 4.

TECHNICAL *and* INDUSTRIAL APPOINTMENTS

Mr. Neil Fenwick has been appointed sales promotion manager of **W. G. Pye and Co. Ltd.,** Granta Works, Newmarket Road, Cambridge.

* * *

Mr. Glenn M. Herring has been appointed assistant to the vice-president, sales, to the **Hanson-Van Winkle-Munning Co.,** Church Street, Matawan, New Jersey. In his new capacity, Mr. Herring will assist in general sales management under Mr. R. M. Norton and will also continue in the management of the Eastern sales district, with headquarters at Matawan.

* * *

Escol Products Ltd., vitreous enamelling engineers, Paisley Works, Swains Road, Tooting Junction, London, S.W.17, have appointed G. F. Keep as sales and service manager and J. Lamont as works manager (frit production) : D. L. Mill has been appointed works manager of **Stewart and Gray Ltd.,** enamelling production.

* * *

Wolf Electric Tools Ltd., London, have just appointed Mr. Klasa van Walraven as sales supervisor for Holland, where for many years, their industrial and domestic portable electric tools have been in popular demand.

* * *

Thornley & Knight Ltd. have recently appointed Mr. Graham J. Muir as technical representative—industrial finishes, in the London area. Mr. Muir has always specialized in industrial finishes and has considerable experience in this field.

FORTY YEARS WITH PAINTS & VARNISHES

On May 5 this year Mr. N. A. Bennett, technical director of **Griffiths Bros. and Co. London Ltd.,** paint and insulating varnish manufacturers of Armour Works, Well Lane, Wednesfield, Staffs, completed forty years' service with the company. Mr. Bennett is a well known figure in the paint world and is past president of the Oil and Colour Chemists Association, chairman of the Sub-Committee of Electrical Research Association on varnishes, managing director of the Ferrubron Mining Co., vice president of Greenwich Boy Scouts Association and is a member of the Industry Committee of the British Standards Institute and the Council of the Paint Research Association.

SITE SHOT-BLASTING

R. J. RICHARDSON and Sons Ltd., Commercial Street, Birmingham 1, have recently formed a new division to be known as Site Shotblasting (Great Britain) Ltd., whose task is to carry out shot-blasting on site of work too large to be catered for by transport into the works of the parent concern. The activity of the concern will cover a wide range such as the cleaning of large bore pipes, oil tanks, gasometers, bridges, steel chimneys and large fabrications including the exterior and interior of ships' hulls and the interior of the tanks of oil tankers.

RETIREMENT

THE Fairey Co. Ltd., 24 Bruton Street, London, W.1, state that Mr. Richard Fairey has retired from the board of directors and relinquished his position as vice-chairman on the advice of his doctors.

NEW COMPANY FOR FINISHING PLANT

G. and R. GILBERT Ltd. announce the formation of a new company to deal with the greatly increased volume of industrial business. The new organisation, G. and R. Gilbert (Industrial) Ltd. will operate from a factory in the same industrial area at Hackbridge Road, Hackbridge, Surrey.

The company will be devoted to the design, manufacture and supply of ovens and special-purpose equipment for general industrial use, plastics, etc. and complete finishing installations including pre-treatment plant, spray booths and conveyors.

New and extended catalogues of the company's products are being prepared and are available on request.

75,000 Visitors at I.E.A.

FINAL attendance figures at the Instruments, Electronics and Automation Exhibition which closed at Olympia on Saturday, May 28, were 75,276. Of these, overseas visitors totalled 4,015 from 61 different countries. Home and overseas representatives of newspapers, trade and technical journals, radio and television who attended the Exhibition totalled 529.

ALFRED Bullows and Sons Ltd., Long Street, Walsall, Staffs, have established a subsidiary company in Australia known as Alfred Bullows and Sons (Aust.) Pty. Ltd., Ethel Avenue, Brookvale, Sydney, N.S.W.

The new company will be under the management of Mr. W. J. Proffitt who has had several years' experience at Bullows' head office at Walsall and will hold the full range of Bullows equipment including Hydrovane air compressors, spray guns, spray painting equipment and the latest development, the "No-pump" spray booth. The accompanying photograph shows part of the new premises.

TECHNICAL BOOKSHELF

1959 Supplements to the 1958 Book of ASTM Standards. American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., U.S.A. 10 parts, total 2932 pp. $40 or $4 per part.

THE book of ASTM Standards is published triennially with supplements in the intervening years and contains well over 2600 standard specifications, methods of test, recommended practices and definitions of terms for materials. Each part-supplement of the 1959 supplement brings the corresponding part of the 1958 Book of Standards up-to-date by including new standards and revisions adopted in 1959. The ten parts are as follows :—

Part 1—Ferrous Metals Specifications. 362 pp.

Part 2—Non-Ferrous Metals Specifications. 280 pp.

Part 3—Methods of Testing Metals. 110 pp.

Part 4—Cement, Concrete, Mortars, Road Materials, Waterproofing, Soils. 200 pp.

Part 5—Masonry Products, Ceramics, Thermal Insulation, Sandwich and Building Constructions, Acoustical Materials, Fire Tests. 218 pp.

Part 6—Wood, Paper, Adhesives, Shipping Containers, Cellulose, Leather. 142 pp.

Part 7—Petroleum Products, Lubricants, Tank Measurements, Engine Tests. 428 pp.

Part 8—Paint, Naval Stores, Aromatic Hydrocarbons, Coal, Coke, Gaseous Fuels, Engine Antifreezes. 252 pp.

Part 9—Plastics, Electrical Insulation, Rubber, Carbon Black. 546 pp.

Part 10—Textiles, Soap, Water, Atmospheric Analysis, Wax Polishes. 394 pp.

Part 1 contains 58 standards, covering amongst others, boiler plates and rivets, sheet and strip, corrosion and heat-resisting steels, structural and rivet steel, coated steel and iron products, ferro-alloys and titanium alloys.

Part 2 includes 38 standards for copper and copper-base alloys, ingot, plate, sheet, strip, rolled bar, shapes, wire, die forgings, pipe and tubes. Also tin, nickel alloys, titanium, materials for electron tubes and semiconductor devices, metal powders and electrodeposited metallic coatings. In addition there are standards for die-cast metals, aluminium and aluminium alloys, magnesium and magnesium alloys, and metallic electrical conductors.

Part 3 includes 14 standards for tests for mechanical properties, effect of temperature, corrosion, electrical and magnetic properties. Also included are non-destructive testing and sampling methods.

Change of Address

THE Magnus Chemical Co. Ltd., Salisbury Road, Uxbridge, Middlesex, state that as from July 1, all enquiries and deliveries will be dealt with from their Midland office at 751 Bristol Road South, Northfields, Birmingham 31, telephone No. Priory 4979. An improved delivery service for the Midlands generally will be introduced and collections can be made from the new stores—Magnus Chemical Co. Ltd., c/o Jennings Transport, London Road, Curdworth, nr. Birmingham.

NEW COMPANIES

Stephan Plant Coe, Silver Street Works, Bollington, nr. Macclesfield, April 28. £1,000. To carry on bus. of metal polishers and light industrial metal workers, etc. Stephan Plant, John K. Coe.

Harrison Bros. and Howson, Sheffield. May 2. £100. To carry on bus. of manfrs. of gold and silver plate and cutlery, etc. Col. Edgar W. Wilkinson, Wm. Howson, Emile Viner, Ruben Viner and Leslie Glatman.

Crel, 29/33 Everton Brow, Liverpool, 3. May 13. £100. To carry on bus. of mfrs. and dlrs. in rubber bonded abrasive, buffing and polishing wheels, etc. Bernard Ross and Mrs. Elsie Ross.

Agricola Metals, 4 Copthall Ave., E.C.2. May 16. £100. To develop metallurgical processes, etc. Directors to be appointed.

Portland Platers, Mill Street, Walsall, Staffs. May 17. £1,000. To cy. on bus. of electro and general platers, etc. Bernard F. Thomas and Phyllis M. Thomas.

South London Autospray, 24 Padfield Road, London, S.E.5. May 20. £250. To carry on bus. of car sprayers etc. Richard Smith, Harold Smith, Reginald G. Tucker.

A. H. Darby, 194 Heath Road, Twickenham, Middx. May 24. £5,000. To cy. on bus. of presstool, precision and light engrs. Arthur H. Darby and Mrs. Ellen F. Darby.

ALCOA International (U.K.), 2 Portman St., W.1. May 26. £100. To promote the sale of all metals, articles, goods and products mnfrd. or sold by Aluminium Co. of America. Du Bose Avery, David C. F. Pearson.

From the Register compiled by Jordan & Sons Ltd. 16 Chancery Lane, London, W.C.2.

INTERNATIONAL FILM CONGRESS

THE Fourteenth Congress of the International Scientific Film Association will be held in Prague from September 16 to 24, 1960, and will include as in previous years a Festival of Films Presenting Science. Upwards of thirty countries are expected to participate with films and the attendance of delegates.

OBITUARY

Urbach. Herman R. Urbach, treasurer and general manager of the O. Hommel Co., Carnegie, Pennsylvania, died suddenly at his home Thursday, June 9. Mr. Urbach had been employed with the O. Hommel Co. since the age of 20 and during the whole of his 57 years with the company had been very active and had made lasting contribution to the ceramic industry. He is survived by his wife and one son, H. G. Urbach, an engineer with Westinghouse Electric Co. He was also past president of the Pittsburgh Paint, Varnish and Lacquer Association and a charter member of the Chartiers Valley Management Association.

* * *

Scott. Mr. T. S. Scott, assistant secretary of the Gauge and Tool Makers' Association since December, 1947, died very suddenly on June 1 in his 58th year, leaving a widow and young son. The funeral was a private one by request, but the Secretary of the Association was there to represent the officers, council and all members.

* * *

Scott. Sir Oswald A. Scott, K.C.M.G., D.S.O., chairman of directors of Detel Products Ltd., Stonefield Way, Victoria Road, Ruislip, Middlesex, died suddenly on May 19.

Trade and Technical Publications

The 1960 edition of Plastics Review issued by Bakelite Ltd. of 12-18 Grosvenor Gardens, London, S.W.1 describes the use of non-slip epoxide compositions for road surfaces and in such places as warehouses, factories, loading bays and ramps where slippery floors provide a hazard which may lead to accidents. The publication also refers to the development in the use of polyester/glass fibre in the manufacture of such components as railway carriage doors which is tending to oust the more conventional type of steel door.

* * *

A new illustrated handbook (Bulletin 23) has just been published by British MonoRail Ltd., describing the MonoRail overhead materials handling system, and showing the ways in which the system is applied to cater for different industrial handling requirements.

The booklet describes the standard precision parts which comprise the system, and which can now be used to provide minimum-headroom underslung cranes with capacities of up to five tons, and, because the crane rails can be supported from the roof, of virtually unlimited span.

A series of case histories is included, demonstrating how this system has been applied in British factories to solve a variety of transportation problems.

Copies of the booklet are available from British MonoRail Ltd., Wakefield Road, Brighouse, Yorkshire.

* * *

The Becco Chemical Division of Food Machinery and Chemical Corporation, Buffalo, New York, have developed a new process for preparing copper for electro-plating, which they claim is quick and simple to use and substantially reduces the porosity of thin electro-deposits. The new plating preparation replaces the conventional acid pickle by a brief dip in a 25 per cent solution of Becco Ammonium Persulphate followed by a warm water rinse and produces an unusually clean surface on the copper, free of oxides, which will not re-oxide quickly. F.M.C. state that tests have shown that the persulphate-cleaned copper surface is much more favourable for the production of a low-porosity electro-deposit than that obtained by other commonly used cleaning and pickling methods; and also offers good plate adherence.

In one case, a hard nickel plate 0.0003 in. thick deposited on the persulphate-cleaned copper showed a 73 per cent reduction in the number of pinholes compared to the same plate deposited from the same bath on an acid-pickled copper; in another case, a Sel-Rex bright cyanide gold plate 0.0002 in. thick deposited on a persulphate-cleaned copper showed an 85 per cent reduction in pinholes.

The new Becco process is inexpensive to use, one gallon of treating solution covering 100 sq. ft. of metal surface and taking only 15 to 30 seconds; conventional treating equipment can be used.

Details of the new copper preparation are contained in Becco Bulletin 109, of which copies will be sent free on request to Becco Chemical Division FMC, Station B, Buffalo 7, New York.

* * *

Burnett and Lewis Ltd., Redhouse Industrial Estate, Aldridge, South Staffordshire, have issued a booklet, "Humidryer," which describes and illustrates some of the fully automatic gas and air drying equipment manufactured by them. This company has been engaged in the production of this type of equipment for many years and in addition to a standard range of driers also undertake the preparation of specialized designs to meet individual needs. The equipment illustrated is designed for both steam and electric re-activation.

* * *

The "Bonderizer," April-May, 1960, published by the Pyrene Co. Ltd., Metal Finishing Division, Great West Road, Brentford, Middlesex, contains several illustrated articles describing developments which have taken place in the use of "Bonderite" and "Bonderlube" to assist in the cold working of aluminium alloys, the drawing of stainless-steel wire and the preparation of stainless, high carbon and mild steel cold heading wire.

* * *

"Paint in Industry," No. 1, published by the Industrial Division of Blundell, Spence and Co. Ltd., 37 Queen Square, London, W.C.1, describes some of the methods used in the application of the surface coatings developed and manufactured at their Industrial Division works on the Slough Trading Estate, Bucks. These air-drying, stoving and cellulose finishes, a large number of which are specially formulated to meet individual requirements, are used for a wide range of products and methods of application include hot and cold spray, electrostatic, dipping, flow-coat, roller-coat and automatic spray. Reference is also made to the production of plastic-coated steel and pre-painted steel or aluminium coiled strip, using roller-coating enamels. The Industrial Division of Blundell, Spence and Co. Ltd. was created last November from three wholly-owned subsidiaries, Vulcan Products Ltd. of Slough, John J. Bowater Ltd. of West Bromwich, and Paint Removers Ltd. "The Blundwagon," March-May, 1960, which is the House Magazine of the Blundell, Spence Group, refers, among other matters, to the use of emulsion paint for the exterior decoration of 90 aluminium pre-fabricated bungalows at Cheltenham which in lively colours has revitalised the former grey monotony.

* * *

Rubery, Owen and Co. Ltd., Whitegate Factory, Wrexham, North Wales, have issued a pamphlet illustrating the new and wide range of re-inforced plastic products which modern methods and facilities enable this company to produce under the title of RO-PLAS. The most advantageous plastic is produced from laminated fibreglass and polyester resin giving a higher strength/weight ratio than mild steel and a higher impact resistance than most metals when judged on a strength/weight basis in addition to having non-corrosive characteristics and the ablity to resist the attack of chemicals.

* * *

The latest edition of "H-VW-M Plating and Polishing News," which is published quarterly by Hanson-Van-Winkle-Munning Co., Church Street, Matawan, N.J., is now available to all members of the metal finishing trade; it is in its thirteenth year of publication and readers are able to keep abreast of the times with this four page brochure featuring the latest equipment, supplies and processes through the research and development laboratories of H-VW-M which is among the largest manufacturers of electro-plating equipment in the world. Future copies of the publication may be obtained by direct application to the company.

* * *

The Dudley Court Machine Co. Ltd. of 2A Parkhurst Road, London, N.7, have produced a booklet entitled "DCMC Industrial Aerosols" giving full details and specifications of the comprehensive range of aerosol packed industrial products including colour coding paints, silicone mould release, rust inhibitor, all-purpose solvent, degreasing fluid, etc.

Latest Developments in PLANT, PROCESSES AND EQUIPMENT

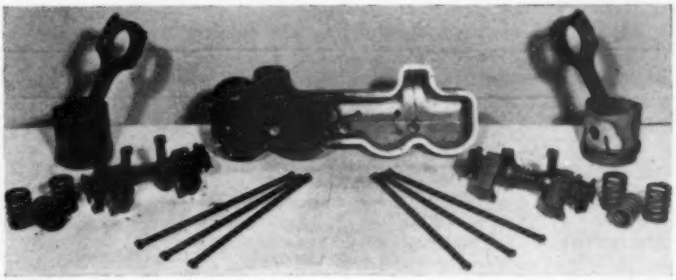


Fig. 1.—Components cleaned in full-strength cleaner.

Cold Cleaner

INDUSTRIAL Colloids Ltd. of Altrincham, Manchester, have introduced a new solution for cold cleaning, " Colosyl 66," which is claimed to give really rapid results in the degreasing, cleaning and decarbonizing of non-ferrous and ferrous metals.

Full strength is recommended for speedy cleaning, degreasing, decarbonisation and removal of heavy soiling matter, dilutions of one part to five parts of water for light degreasing and the removal of swarf from machined parts in production, drawing compounds etc. and the addition of kerosene instead of water where heavier deposits have to be removed. One part of " Colosyl 66 " to three parts of water is claimed to provide an excellent cleaning solution for air or oil filters.

The times of immersion vary from minutes to two hours depending upon the type and density of deposits to be removed and particularly heavy and hard carbon deposits such as are encountered on some cylinder heads can be satisfactorily dealt with by an over-night soak. After immersion the cleaning operation is simply completed by hosing or swilling with hot or cold water.

It is claimed, also, that the solution has a very long operational life and tanks can be maintained over lengthy periods depending on the nature and amount of deposit to be removed. It is non-acid, non-toxic and is said to be quite safe in use.

The items shown in Fig. 1 were cleaned in a full-strength solution for 30 minutes.

Mains-operated Portable *p*H Meter

ANALYTICAL Measurements Ltd., Dome Buildings, The Quadrant, Richmond, Surrey, have produced a new model in *p*H instrumentation, the Model 700 Big Scale *p*H meter, which makes it simple to read *p*H values within 0.02 pH and can be used wherever a standard a.c. voltage is available. The instrument weighs only 5 lb. and can be carried in one hand to enable it to be used where it is needed, thus enhancing its versatility and usefulness ; it is claimed to be the only instrument of its kind to provide a truly big scale so that it can be read easily and quickly.

The model features a single operating control and a high output electronically modulated amplifier with printed circuitry and sensitive meter elimination and is provided complete with probe unit, buffer and KCl solutions as well as temperature compensation.

Protection of Ship's Stabilizers

AMONG the most vulnerable parts of modern ocean-going liners are the stabilizer fins, which are particularly subject to the ravages of erosion and cavitation caused by turbulent water, the general effect of which is to develop pitting of the metal. Coatings of exceptional strength are required to withstand this continuous action and one such preparation has been claimed to be perfected by Jenson and Nicholson Ltd., of Stratford and marketed under the name of Debecote. The new preparation is a specially compounded cement coating which dries to an extremely hard surface, has excellent adhesion and resistance to dimensional changes, expanding and contracting under extremes of temperature without danger of premature film rupture ; as it is resistant to most chemical reactions it has also been found suitable for the protection of freshwater tanks as well as ships' propellers, stern plates and rudders. Among the liners recently treated with Debecote are the Queen Elizabeth, R.M.S. Saxonia, Ivernia and the new French liner " France."

Combined Filter, Airline Lubricator and Regulator

B.E.N. Patents Ltd. of High Wycombe have introduced the Controlube Unit (Fig. 2) which, by ensuring clean, controlled airline lubrication, is claimed to reduce maintenance and prolong the service life of air powered motors, tools, cylinders, valves etc. The three components embodied in the device are :—

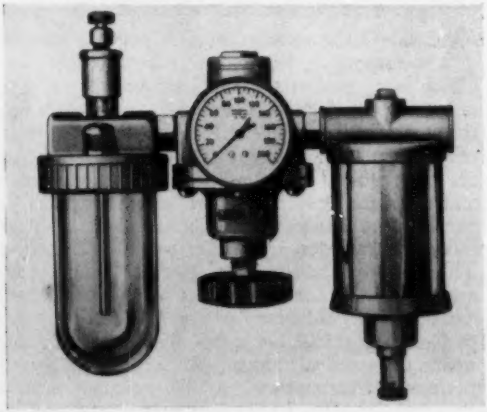
(a) No. 238 moisture separator for the efficient removal of condensed water and other impurities from the compressed air line. Fitted with replaceable filter and supplied complete with drain cock.

(b) No. 233R pressure reducing valve complete with pressure gauge for use where it is necessary to reduce the main line air pressure for different services. A special relieving feature is incorporated which automatically increases or decreases pressure on the outlet side to the pre-set figure on the dial of the pressure gauge. Fitted with Neoprene diaphragm which ensures long life.

(c) No. 276a replaceable bowl lubricator to provide lubrication for all types of pneumatic tools by means of a regulated airborne oil fog. The oil flow is automatic and the rate of feed clearly visible through the sight glass. The oil feed is easily and accurately adjustable by the screw at the top of the lubricator. Refilling can be done without closing air flow.

For airline systems where a pressure reducing valve or other form of pressure control is already installed, the Controlube Minor which comprises a moisture separator and a lubricator can be supplied.

Fig. 2.—Combined fitter, airline lubricator and regulator.



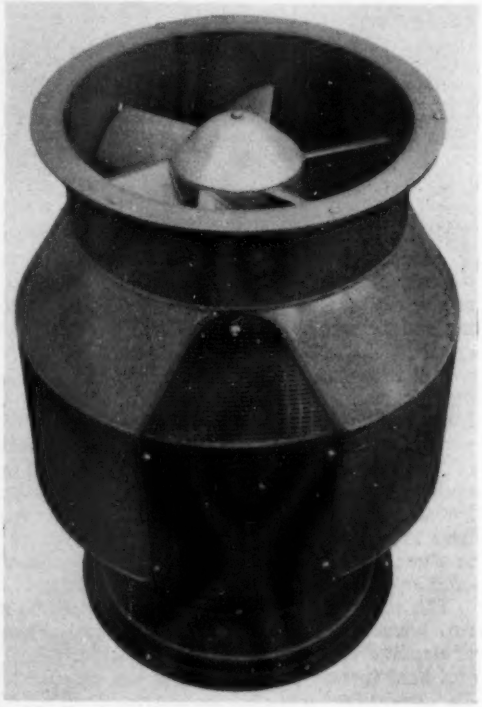
Bifurcated P.V.C. Fans

TURNER and Brown Ltd., chemical plant engineers of Bolton announce that, in conjunction with Matthews and Yates Ltd., fan engineers, Swinton, Manchester, they have added to their " Turbro-Cyclone " p.v.c. centrifugal fans a range of bifurcated fans for the removal of fumes.

Using true aerofoil section blades in rigid p.v.c. and improved technique in the formation of the cases, manufacturers claim unsurpassed performance and construction.

Fig. 3 shows an 18-in. dia. " Turbro-Cyclone " Bifurcated fan which is one of a variety of sizes available up to 30 in. dia.

Fig. 3.—Bifurcated fan with P.V.C. blades.



Zinc-Aluminium Alloy Spray Coating

F. W. BERK and Co. Ltd., Brent Crescent, North Circular Road, London, N.W.10 have produced a metal sprayed coating called " Berkalloy," which is a zinc-aluminium alloy in powder form and which can be used with any modern powder flame spraying equipment for the prevention of corrosion of iron and steel. The coating is claimed to combine the acid resistant qualities of aluminium with the alkaline-resistant qualities of zinc and tests over a period of 8 years have shown that the coating gives equal protection in both conditions.

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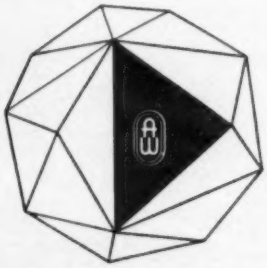

SBSF is the new nickel plating bath based on PB-SF, a sulphur-free addition agent for use where maximum corrosion resistance is required.

SBSF has excellent levelling characteristics and produces a uniform semi-bright deposit of high ductility and low internal stress. This semi-bright finish can be buffed. Alternatively a further deposit, from a Plusbrite Nickel (PB-N1 and PB-N2) electrolyte will produce a fully bright nickel plate particularly suitable for car trim and similar products which require a bright finish and good corrosion resistance. Plusbrite addition agents are easily controlled and are not removed by filtration, so operating costs are kept to a minimum.

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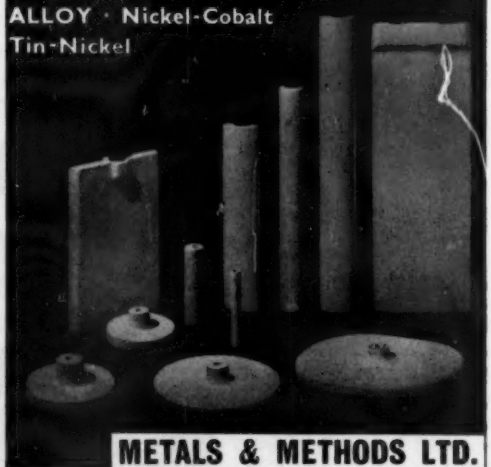

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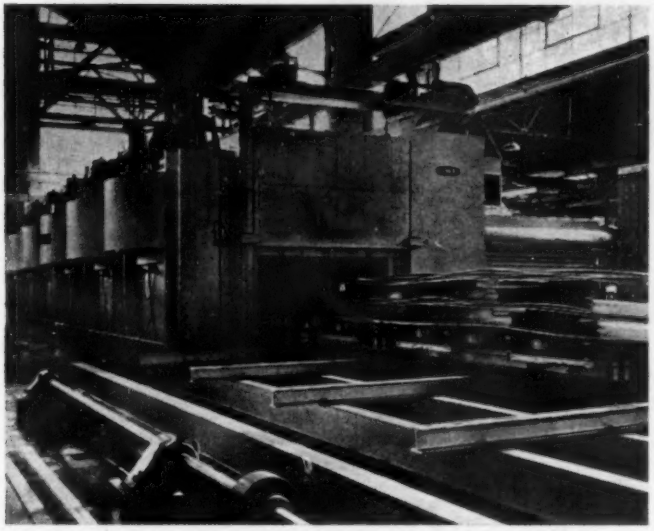

Accommodates slab lengths of 65 ft. x 6 ft. 6 ins.

In the recent large-scale development programme spread over some 30 months, the Northern Aluminium Co. Ltd. has introduced considerable quantities of new plant and handling equipment. A new batch-type furnace, designed and erected by G.W.B. at the Banbury Works of Northern Aluminium, was part of this programme. Production at Banbury, both in aluminium and a variety of aluminium alloys, embraces a wide range of sheets, discs and coils.

Owing to the occurrence of a certain amount of work-hardening (8 in. thick ingots of aluminium are hot rolled to a thickness of approximately 0.3 to 0.5 in.) it is necessary for slabs to be annealed prior to being cold rolled to lighter gauges. The rating of this G.W.B. furnace is 1,000 kW and it comprises six independent and automatically controlled zones of equal length. Rating distribution is as follows: Zone 1 220 kW, Zones 2-5 150 kW each, Zone 6 180 kW. *Owing to the high rating, cycle times as low as 4 hours are regularly obtained.* The maximum temperature of the furnace is 600°C, normal operating temperature being rather lower than this figure.

The heating chamber is lined throughout with heat-resisting alloy, backed by a thick wall of Moler insulating bricks, thus reducing heat losses to a minimum. The furnace casing is constructed from sheet mild steel braced with steel rolled sections and fitted with a mild steel front plate. A cast-framed, refractory faced, fully insulated and counter-balanced door, driven by electric motor, is sealed against the furnace face by pneumatic clamps, thus minimizing heat losses at the furnace entrance. The furnace is supported clear of the ground.

Nickel-chromium strip heating elements, arranged on removable plugs, are situated in the roof chamber, and each zone is fitted with a forced-air circulation system directed cross-flow from the fan, through the heating elements contained in the ducted portion of heating chamber, down into the treatment chamber, and back into the fan for re-circulation. Radiation on to the charge is prevented by a special baffle fitted in the roof chamber to separate the heating elements from the actual working area. Baffles, each independently adjustable and extending the full length of the chamber on each side, direct the air flow to give desired flow characteristics and equalise the temperature throughout the working chamber.

Six air circulating fans are fitted, one per zone. A cooling chamber, similar in size to the heating chamber is incorporated in the unit. A G.W.B. single track charging machine serves both the furnace and the cooling chamber.

As a result of the modernisation, the new rolling mills can roll aluminium sheet to a maximum width of 6 ft. 6 in.; the previous maximum had been 5 ft. The G.W.B. furnace naturally was designed to handle this increased width. It can accommodate loads up to 16 tons for slab lengths of 65 ft. The furnace is normally used to treat slabs of heavy-duty materials for varied employment: Aircraft, coachwork, decorative finishes, car trimming and a host of other uses.

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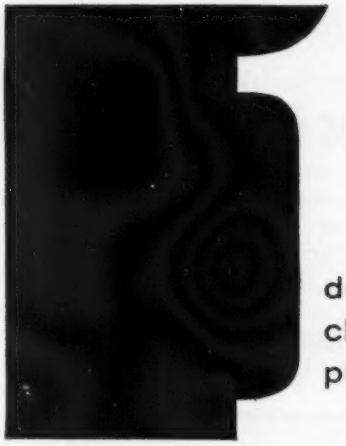

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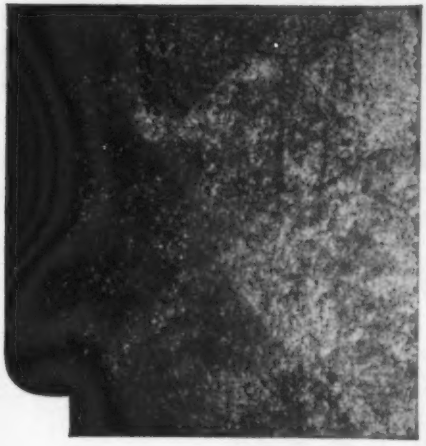

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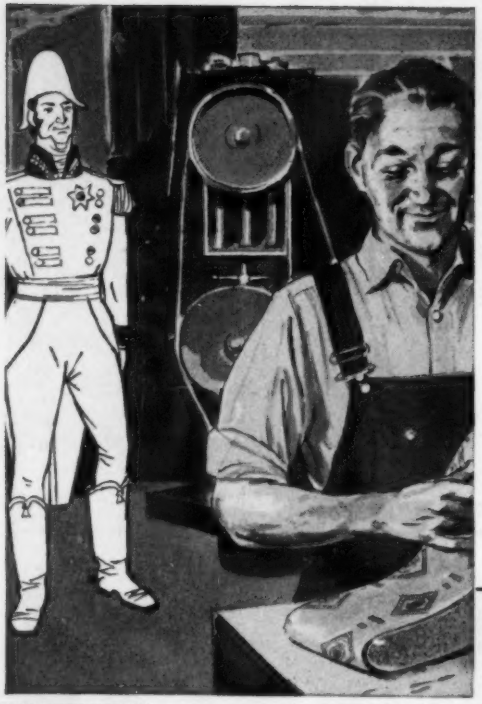

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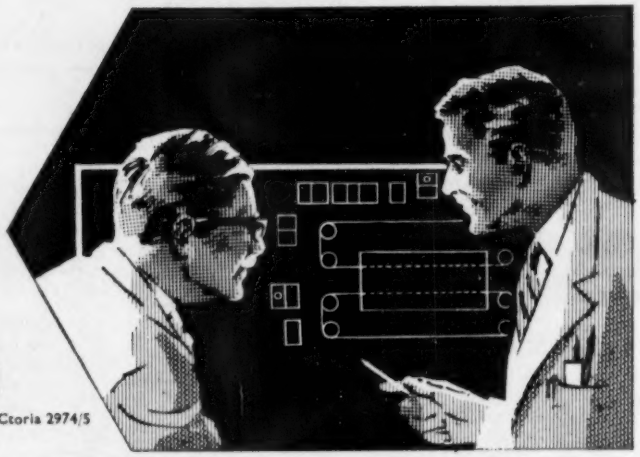

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